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A MODEL TO PREDICT MUTUAL INTERFERENCE EFFECTS ON AN AIRFRAME

Priscilla A. Dwyer
of
IIT Research Institute
Under Contract to
DEPARTMENT OF DEFENSE
Electromagnetic Compatibility Analysis Center
Annapolis, Maryland 21402

October 1976

FINAL REPORT

PUBLISHED APRIL 1977

Document is available to the public through the National Technical Information Service, Springfield, Virginia 22161

Prepared for

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
Systems Research & Development Service
Washington, DC 20591

FAA-RD-76-50

The contents of this report reflect the views of DoD Electromagnetic Compatibility Analysis Center which is responsible for the analysis presented herein. The contents do not necessarily reflect the official views or policy of the Department of Transportation. This report does not constitute a standard, specification or regulation.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-RD-76-50		

4. Title and Subtitle

(6) A MODEL TO PREDICT MUTUAL INTERFERENCE EFFECTS ON AN AIRFRAME

5. Report Date

(11) Oct[redacted]976

6. Performing Organization Code

(12) 167p.

7. Author(s)

(10) Priscilla A. Dwyer of IIT Research Institute

8. Performing Organization Report No.

ECAC-PR-76-067

9. Performing Organization Name and Address

DoD Electromagnetic Compatibility Analysis Center
North Severn
Annapolis, Maryland 21402

(15) F19628-76-C-0017

10. Work Unit No.

(16) 649E

65704

11. Contract or Grant No.

DOT-FA70WAI-175 TASK-26

13. Type of Report and Period Covered

(9) FINAL REPORT

12. Sponsoring Agency Name and Address

Department of Transportation
Federal Aviation Administration
Systems Research and Development Service
Washington, D.C. 20591

14. Sponsoring Agency Code

ARD-60

15. Supplementary Notes

Performed for the Frequency Management Division, Spectrum Plans and Programs Branch, FAA. (18) ECAC, FAA-RD (19) PR-76-067, 76-50

16. Abstract

Sponsored by the FAA, the Electromagnetic Compatibility Analysis Center has developed an analysis model, called AVPAK, to determine the mutual interference effects of introducing new avionics equipment to an existing airframe containing operational equipment. The model has been updated, improved, and expanded in a series of scheduled efforts. In this report, those improvements have been summarized and the current version of the model (AVPAK 3) is completely documented.

175 350

17. Key Words	18. Distribution Statement
INTERFERENCE ANALYSIS AIRFRAME SIMULATION SPATIAL POWER DENSITY FAR FIELD COUPLING	Document is available through the National Technical Information Service, Springfield, Virginia, 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
UNCLASSIFIED	UNCLASSIFIED	156	

Form DOT F 1700.7 (8-69)

METRIC CONVERSION FACTORS

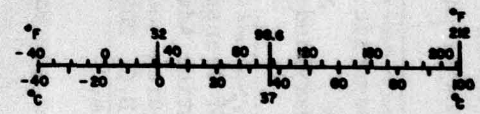
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



FEDERAL AVIATION ADMINISTRATION
SYSTEMS RESEARCH AND DEVELOPMENT SERVICE
SPECTRUM MANAGEMENT STAFF

STATEMENT OF MISSION

The mission of the Spectrum Management Staff is to assist the Department of State, Office of Telecommunications Policy, and the Federal Communications Commission in assuring the FAA's and the nation's aviation interests with sufficient protected electromagnetic telecommunications resources throughout the world to provide for the safe conduct of aeronautical flight by fostering effective and efficient use of a natural resource--the electromagnetic radio-frequency spectrum.

This objective is achieved through the following services:

- Planning and defending the acquisition and retention of sufficient radio-frequency spectrum to support the aeronautical interests of the nation, at home and abroad, and spectrum standardization for the world's aviation community.

- Providing research, analysis, engineering, and evaluation in the development of spectrum related policy, planning, standards, criteria, measurement equipment, and measurement techniques.

- Conducting electromagnetic compatibility analyses to determine intra/inter-system viability and design parameters, to assure certification of adequate spectrum to support system operational use and projected growth patterns, to defend the aeronautical services spectrum from encroachment by others, and to provide for the efficient use of the aeronautical spectrum.

- Developing automated frequency-selection computer programs/routines to provide frequency planning, frequency assignment, and spectrum analysis capabilities in the spectrum supporting the National Airspace System.

- Providing spectrum management consultation, assistance, and guidance to all aviation interests, users, and providers of equipment and services, both national and international.

PREFACE

The Electromagnetic Compatibility Analysis Center (ECAC) is a Department of Defense facility, established to provide advice and assistance on electromagnetic compatibility matters to the Secretary of Defense, the Joint Chiefs of Staff, the military department and other DoD components. The Center, located at North Severn, Annapolis, Maryland 21402, is under executive control of the Office of the Secretary of Defense, Director of Telecommunications and Command and Control Systems and the Chairman, Joints Chiefs of Staff, or their designees, who jointly provide policy guidance, assign projects, and establish priorities. ECAC functions under the direction of the Secretary of the Air Force and the management and technical direction of the Center are provided by military and civil service personnel. The technical operations function is provided through an Air Force sponsored contract with the IIT Research Institute (IITRI).

This report was prepared for the Systems Research and Development Service of the Federal Aviation Administration in accordance with Interagency Agreement DOT-FA70WAI-175, as part of AF Project 649E under Contract F-19628-76-C-0017, by the staff of the IIT Research Institute at the Department of Defense Electromagnetic Compatibility Analysis Center.

To the extent possible, all abbreviations and symbols used in this report are taken from American Standard Y10.19 (1967) "Units Used in Electrical Science and Electrical Engineering" issued by the United States of America Standards Institute.

Reviewed by:

for PRISCILLA A. DWYER
Project Engineer, IITRI

J. M. DETERDING
Director of Contractor Operations

Approved by:

for R. E. BEERY
Colonel, USAF
Director

M. A. SKEATH
Special Projects
Deputy Director

EXECUTIVE SUMMARY

The Electromagnetic Compatibility Analysis Center (ECAC) has developed an analysis model (AVPAK) to determine the mutual effects of introducing new avionics equipment to an existing airframe containing operational equipment. This was accomplished in response to a request by the Federal Aviation Administration (FAA). The present model (AVPAK 3) is the result of the third phase of work in this area.

The analysis of the mutual effects of the operation of equipment on an airframe is accomplished by predicting the expected level of interference relative to the degradation threshold of each receiver. Antennas are assumed to be isotropic and may be collocated on the aircraft or on a neighboring aircraft. Equipment examined for possible interference include those with overlapping or immediately adjacent operating frequencies and also those with harmonically related operating frequencies for which inadequate transmitter harmonic attenuation exists. Nonlinear effects are not included in the analysis and must be dealt with manually. To insure that only far field coupling conditions are considered, only those equipments operating above 30 MHz are treated.

The model offers the option of either a purely deterministic calculation or a probabilistic calculation that estimates the probability of interference. The body of the airframe is modeled as a cylinder of finite length to which appropriate conical sections may be added. The calculation takes into account the factors of airframe curvature, airfoil obstructions, and bulkhead obstruction.

Two data bases are associated with the model. One contains nominal characteristics of commonly used avionics equipment which may be directly called upon to run the model. The model contains a mode which allows user-specified data to be used in running the program for new equipment types or equipment not described in the data base. The other data base contains median values and standard deviations of selected characteristics for equipments grouped according to function. One set of characteristics, based on median values, is then used to represent the group. This information is used in probabilistic processing.

As part of this task the existing AVPAK data bases were expanded with new avionics equipment obtained since the last updating in 1973.

In addition to interference analysis, the model calculates the power density at user-specified points, resulting from the operation of transmitters located on an aircraft. These points

EXECUTIVE SUMMARY (Continued)

may be located anywhere on the airframe, including wing pods, or they may be "raised" from the airframe (i.e., not lying on the fuselage skin), including locations on neighboring aircraft. The model also has the capability of calculating a cumulative power density due to the effects of more than one transmitter.

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LIST OF ACRONYMS

ARINC EC	-	ARINC Research Corporation Equipment Characteristic -- used to indicate to prospective manufacturers the characteristics of new equipment desired by the airline industry.
ATACAP	-	Antenna-to-Antenna Analysis Program, developed by the McDonnell-Douglas Corp. for the U.S. Air Force.
ATCRBS	-	The national Air Traffic Control Radar Beacon System, operated by the FAA.
AVBASE	-	The portion of the AVPAK data base containing equipment data to support deterministic analysis of EMC problems.
AVFILE	-	The portion of the AVPAK data base containing equipment functional characteristics to support probabilistic analysis of EMC problems.
AVPAK	-	The Avionics Interference Prediction Model, developed by ECAC under sponsorship of the FAA. The model, the latest version of which is AVPAK 3, is employed to analyze and predict interference among antennas on an airframe.
DME	-	Distance Measuring Equipment.
ECAC	-	The Department of Defense Electromagnetic Compatibility Analysis Center, Annapolis, MD.
EMC	-	Electromagnetic compatibility.
FAA	-	The Federal Aviation Administration of the Department of Transportation.
FAS	-	Frequency Analysis System -- an ECAC analysis program that includes the capability to synthesize transmitter spectral-emission and receiver response characteristics, and predict their interactions.
GTD	-	Geometric Theory of Diffraction.
ROFR	-	Receiver contribution to receiver off-frequency rejection.

LIST OF ACRONYMS (Continued)

SCSE - ECAC's Smooth-Curve, Smooth-Earth propagation model.

TACAN - TACtical Air Navigation system.

TOFR - Transmitter contribution to receiver off-frequency rejection.

TSO - Technical Standard Order, promulgated by the FAA -- contains minimum performance and quality-control standards for materials, parts and appliances used on civilian aircraft.

VOR - VHF Omni-Range system.

SECTION 1

INTRODUCTION

BACKGROUND

In 1969, the Federal Aviation Administration tasked ECAC to develop an automated interference analysis capability for use with avionics equipment in aircraft. The capability was for general application, but particularly useful when a new equipment was to be introduced to an existing airframe containing operational equipment. That effort was completed in December 1970.[1]

In 1972, FAA requested that the capability be extended, notably to allow probabilistic analyses. Certain other improvements were also added, and additional measured data was obtained for further validation of the antenna coupling portion of the model. The report of that effort was published in 1973.[2]

In 1974, FAA again requested that ECAC undertake a task for improving the model and incorporating features that had become available since publication of the second report. A comparison of this report with References 1 and 2 will reveal much repetitious material. It was necessary to include such material here in order to satisfy the FAA requirement for a single document describing the capability. Future reference to the previous reports for an understanding of the application and use of the prediction capability and data base will be unnecessary.

Throughout this report, where it is desired to distinguish between the early model, the intermediate model and this latest model, they will be characterized as AVPAK 1, AVPAK 2 and AVPAK 3, respectively. It should be understood that AVPAK 1 and AVPAK 2 no longer exist. AVPAK 3, of course, has all the capabilities of the first two versions as well as the improvements described herein.

OBJECTIVES

The objectives of this project were to:

1. Incorporate a power density model in AVPAK.
2. Incorporate an airfoil-shading model.

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[1]Morgan, G., *Avionics Interference Prediction Model*, ESD-TR-70-286, December 1970. (FAA Report No. FAA-RD-71-10.)

[2]Friske, L., *An Extended Avionics Interference Prediction Model*, ECAC-PR-73-002, June 1973. (FAA Report No. FAA-RD-73-9.)

3. Develop a model for predicting coupling between two antennas whose locations are raised from the airframe.

4. Expand the avionics-equipment data base.

5. Refine and regroup equipment data to arrive at smaller variances for use in probabilistic analyses.

6. Validate the above additions to the model.

7. Document the prediction model and data base to provide a single technical report describing the capability.

APPROACH

The following steps were taken to accomplish the specific objectives of the project.

1. Certain techniques for computing air-foil shading were known to exist. These were analyzed and a validation was undertaken. They were found to be unsatisfactory and an empirical model was developed.

2. A technique for computing power density was incorporated into AVPAK.

3. Additional manufacturers' technical manuals were obtained. Data were extracted from the manuals for inclusion in the AVPAK data bases. New classifications were established, leading to smaller variances in the probabilistic data base.

4. Additional coupling loss data were obtained and additional verification of the coupling model was performed.

SECTION 2

MODEL EXTENSION

GENERAL

The purpose of this section is to discuss changes made to the analysis and data base capabilities, to report the options that were open, and to justify the selections and decisions finally made. Section 3 of this report describes the entire capability as it now exists.

DEVELOPMENT OF AN AIRFOIL OBSTRUCTION LOSS

The initial plan for satisfying the airfoil obstruction-loss task was to investigate existing obstruction models and theories and determine if their use in the AVPAK model was feasible.

The first area investigated involved work done by the McDonnell Douglas Corporation and the Grumman Aerospace Corporation in two separate ventures where wing obstruction attenuation was determined through diffraction effects. Because of the necessity to limit the detail associated with input parameters, it was not feasible to incorporate either of these models in the AVPAK model.

An attempt was made to model an airfoil as a knife-edge obstruction. When this yielded inaccurate results, a decision was made to develop a model to account for obstructed paths -- one which could be easily assimilated into the AVPAK model. Each of these developments in the obstruction-loss task is discussed below.

McDonnell Douglas Model (ATACAP)

An antenna-to-antenna compatibility analysis program (ATACAP) was developed by the McDonnell Douglas Corporation under USAF contract as part of a larger intra-vehicle electromagnetic compatibility analysis program.[3]

ATACAP, like the Avionics Interference Prediction Model, contains not only antenna-coupling routines but receiver and transmitter synthesis models. Only the antenna coupling was of interest here since ATACAP includes provision for predicting the additional loss introduced by wings. This additional loss is based on the Geometrical

[3] Bogdanor, J. L., Siegal, M. D., Weinstock, G. L., *Intra-Vehicle Electromagnetic Compatibility Analysis, Part I*, McDonnell Aircraft Company, McDonnell Douglas Corporation, TR AFAL-TR-71 155 PTI, January 1972.

Theory of Diffraction (which is explained in some detail below and in APPENDIX A).

Documentation and a program listing for ATACAP were obtained and evaluated for applicability to the requirements of FAA. The evaluation revealed apparent irregularities that could not be accounted for either by analysis or consultation with McDonnell-Douglas. For that reason, the ATACAP effort was terminated and an attempt was made to use basic work on the Geometric Theory of Diffraction.

Geometric Theory of Diffraction

The Geometric Theory of Diffraction is an extension of geometrical optical theory which has been widely used to solve antenna problems; e.g., the determination of antenna patterns for multi-element arrays, high gain reflectors and dielectric lenses.

Geometric optics theory, however, fails to account for diffraction which occurs when the incident ray hits edges, corners, apexes of surfaces, or is tangent to a smooth surface. GTD was developed to account for these optical phenomena of diffraction.[4]

An exposition of the ECAC inquiry into GTD for modeling obstuctions between aircraft antennas appears in APPENDIX A. It was determined that the geometric detail necessary to use such a model would be available only after precision measurements of aircraft geometry. Because of this limitation GTD was rejected as an acceptable obstruction-modeling technique.

Knife Edge Diffraction

The classic Bullington equation, used by the model to calculate transmission loss over a bulkhead obstruction, was considered initially for calculating the loss around an airfoil obstruction. However, it was found that this technique does not yield verifiable results. Therefore, it was abandoned for calculating airfoil obstruction losses.

Empirical Airfoil Obstruction Model

Since none of the investigated methods yielded the desired results in terms of accuracy in predicting obstructed-path coupling

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[4]Sacks, L. H., *The Geometrical Theory of Diffraction Applied to Aircraft Antenna Isolation Determination, Parts I and II*, No. RF-67-10, Grumman Aerospace Corp., May 1967.

losses, an empirical method to compute airfoil obstruction loss was developed at ECAC. Through inspection of measured path losses where airfoil obstructions existed, it was determined that obstruction loss could be approximated by calculating the free-space loss around the airfoil and adding a curvature factor (see Figure 1). The free-space loss is obtained from the following equation:

$$L_{FS} = 20 \log D + 20 \log f - 38 \qquad (1)$$

where

L_{FS} = free-space loss in dB

D = minimum distance around airfoil, in feet

f = transmitter frequency, in MHz.

The curvature loss is obtained from the curvature loss function $F(y)$, which is discussed in Section 3. For an airfoil obstruction, in calculating $F(y)$, the length of the ray path between the two antennas is the minimum-distance path between the antennas, (through the airfoil).

The chords of all airfoils are assumed to be parallel to the Z-axis. If the airfoil-fuselage chord does not lie parallel to the Z-axis, the chord will be set parallel to the Z-axis in the program, with reference to the front airfoil-fuselage intersection point. An airfoil obstruction loss will be calculated if antennas are located in the following areas (see Figure 2). Both antennas must be located within ±20 degrees of the top or bottom fuselage centerline and lie on the fuselage. They also must be located so that there is full airfoil obstruction. This is determined by comparing the Z-axis coordinates of the two antennas with those of the forward and aft wing-fuselage intersection points. Let (x_1, y_1, z_1) and (x_2, y_2, z_2) be the coordinates of the two antennas and (x_3, y_3, z_3) and (x_4, y_4, z_4) the coordinates of the forward airfoil-fuselage intersection point and aft airfoil-fuselage intersection point, respectively. Airfoil shading is calculated if:

$$1)\quad (z_3 - \varepsilon) < z_1 < (z_4 + \varepsilon) \text{ and } z_3 < z_2 < z_4 \qquad (2a)$$

or

$$2)\quad (z_3 - \varepsilon) < z_2 < (z_4 + \varepsilon) \text{ and } z_3 < z_1 < z_4 \qquad (2b)$$

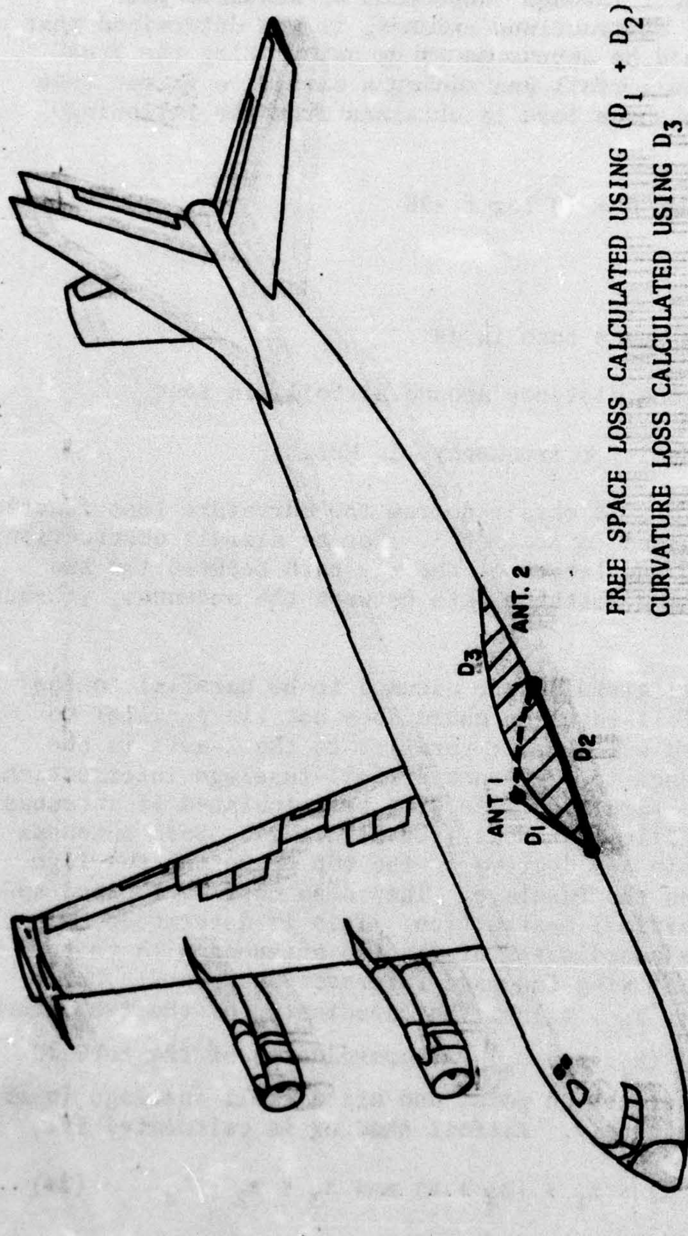

Figure 1. For cases where airfoil obstructions exist, a combination of free space and curvature loss is used.

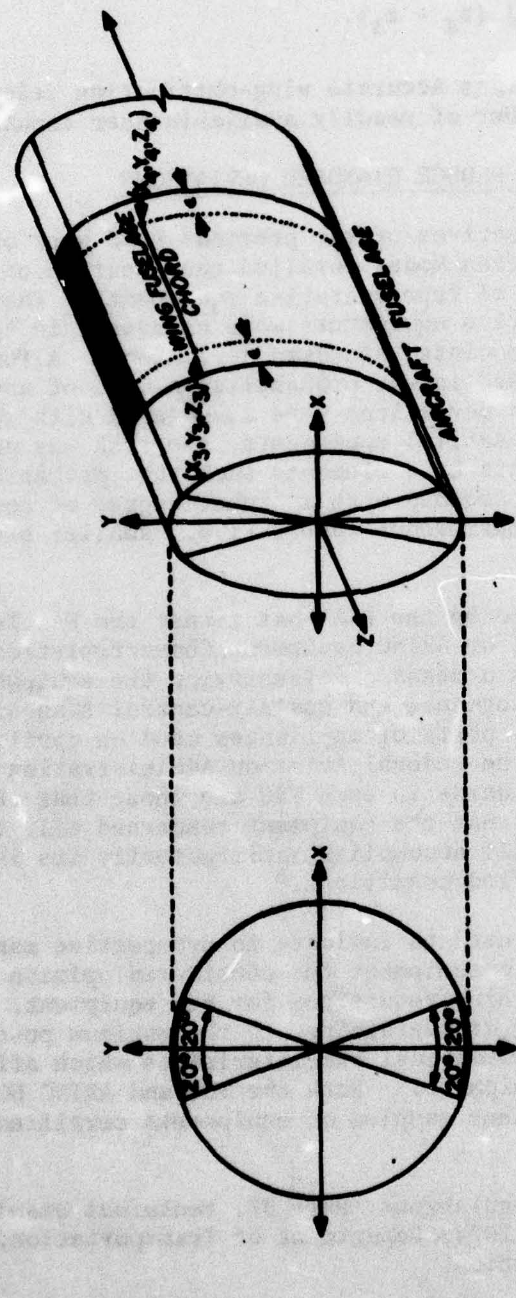

Figure 2. The AVPAK 3 model will calculate an airfoil obstruction loss if antennas are lying on the fuselage skin in the darkened area above.

where

$$\varepsilon = (.1)\ (z_4 - z_3).$$

This technique provides accurate wing-obstruction calculations using a minimum number of readily available user inputs.

RECLASSIFICATION TO REDUCE STANDARD DEVIATIONS

One of the objectives of the previous ECAC work on the Avionics Interference Prediction Model entailed the creation of a functional data base comprised of representative equipments. The parameters of these representative equipments were expressed in terms of mean values and their associated standard deviations. A functional representation is used in the probabilistic mode of analysis. Since large standard deviations were associated with some of the functional (representative) equipments, the task was undertaken to reclassify the data base elements such that probabilistic analyses could be performed with a higher degree of confidence in the predicted interference levels (i.e., smaller standard deviations).

It was suggested by the FAA that either the FAA Technical Standard Order (TSO) or ARINC Equipment Characteristics (ARINC EC) be considered as a means of classifying the equipment. TSO's contain minimum performance and quality-control standards for specified materials, parts or appliances used on civilian aircraft. They are issued by the Federal Aviation Administration (FAA), and the performance standards in each TSO are those that the FAA finds necessary to ensure that the equipment concerned will operate satisfactorily or will accomplish satisfactorily its intended purpose under specified conditions.[5]

An ARINC EC is used to indicate to prospective manufacturers of airline electronic equipment the considered opinion of the airline industry concerning requisites for new equipment. They also serve the purpose of standardizing, to the maximum possible extent, those physical and electrical characteristics which affect interchangeability of equipment.[6] Both the TSO and ARINC EC were examined to see whether samples of equipments certified to meet

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[5]Federal Aviation Regulations, *Part 37, Technical Standard Order Authorization,* May 1974, Department of Transportation, Federal Aviation Administration.

[6]ARINC Characteristic #579-1. Aeronautical Radio, Inc., 2551 Riva Rd, Annapolis, MD 21401, 5 February 1971.

the requirements of either (or both) of them were characterized by smaller (or larger) standard deviations. No such correlation could be found. In some cases, for example, sharper selectivity characteristics are associated with communications receivers that are not certified to meet either a TSO or ARINC EC than with equipment so certified.

Nominal characteristics provided by manufacturers do not always indicate the true characteristics of equipment. That is, nominal values are cited for selectivity, for example, that meet some specification requirement when in fact the selectivity may be far superior to that representation. This practice would, of course, make variances quite wide when some values are based upon these nominal characteristics and others are actual values.

Other approaches were taken to the reclassification problem. For example, equipments were ranked by standard deviation of pertinent characteristics, and then they were examined for other common or similar characteristics. It was decided that there was no nominally stated feature upon which to base classification.

Therefore, equipment types associated with large standard deviations (viz. VHF communications receivers and VOR/Localizer receivers) were subclassified according to the highest recorded spurious-response levels in each category. Three subclasses were used, as follows:

Subclass	Relative Spurious Response Level
1	40 - 89 dB down
2	90 - 109 dB down
3	110 - 140 dB down

POWER DENSITY MODEL

An earlier ECAC effort was involved with the evaluation of the electromagnetic environment at different points on an aircraft. This effort developed the capability of calculating power densities resulting from transmitters located on the aircraft as well as from transmitters located on neighboring aircraft. This model has been incorporated into AVPAK 3. Details on the power density model are contained in the model description section of this report (see pg. 43).

SECTION 3

MODEL DESCRIPTION

GENERAL

In determining possible interference cases, the AVPAK 3 model utilizes two major analyses. One calculates the path loss between isotropic radiators located on an airframe, raised from an airframe, or on neighboring aircraft. An antenna gain subroutine provides gain in the direction of coupling for certain types of aperture antennas while non-aperture antennas are assigned a nominal gain value. The other major analysis determines the rejection offered by a receiver to an undesired signal. This is accomplished by integrating over the areas of frequency overlap between the spectral emission of a chosen transmitter and the receiver response characteristic of a chosen receiver. For equipment such as ATC transceivers that operate over a range of frequencies, the entire operating range is examined; in this manner "worst case" values for rejection are determined.

Also included in the AVPAK model is the capability to calculate power density at receivers or user-specified points due to a number of transmitters (up to 50).

Nonlinear effects such as intermodulation, cross-modulation, receiver desensitization and specific spurious responses are not included in AVPAK 3 and must be treated manually.

In creating the AVPAK 3 model, the desired new features and capabilities were added to the AVPAK 2 format. The specific capabilities of the earlier AVPAK models and the new features included in the AVPAK 3 model are discussed below.

BASIC INTERFERENCE EXPRESSION

The analysis of the mutual effects of the operation of equipment on an airframe is accomplished by predicting the expected level of interference relative to the degradation threshold of each receiver.

The undesired interfering power at the input terminals of a potential victim receiver can be calculated with the logarithmic form of the one-way system loss equation, which is:

$$P_I = P_T + G_T + G_R - L_P - L_s \qquad (3)$$

where

P_I = the input interfering power in dBm

P_T = the transmitter output power in dBm

G_T = the effective gain of the transmitting antenna in the direction of the receiving antenna in dBi

G_R = the effective gain of the receiving antenna in the direction of the transmitting antenna in dBi

L_P = the basic transmission loss between isotropic radiators in dB

L_s = the combined system losses associated with the transmitter and receiver due to transmission links, coupling devices, and external RF filtering, in dB.

Except for coupling mismatches, the system losses can usually be neglected. It is assumed herein that such losses are negligible. Therefore, the L_s term is dropped from further consideration at this time, but the capability to include such a factor has been retained for future application.

The minimum level of an input desired signal required to produce a standard response is defined as the receiver sensitivity, R_s. The level of an interfering signal required to produce the same standard response in the receiver may be different. The two factors which can cause this difference are the different modulation characteristics of the interfering and desired signals, and the rejection to an off-tune interfering signal offered by the selectivity characteristic of the receiver. These factors can be considered together as the total receiver rejection factor (L_f).

There is an equivalent on-tune input signal power that would produce the same response at the output as the interfering signal. It is related to the interfering signal by:

$$P_{ie} = P_I - L_f \tag{4}$$

where

P_{ie} = the equivalent on-tune input signal power that produces the same output response as the interfering signal. (If $P_{ie} = R_s$, the output would be a standard response.)

By substitution in Equation 3:

$$P_{ie} = P_T + G_T + G_R - L_P - L_f \tag{5}$$

The level of degradation caused by an interfering signal can be evaluated by comparing the resulting signal-to-interference ratio to the required threshold S/I ratio. If it is assumed that the input desired signal is at the receiver sensitivity level, the relative degradation level is:

$$P_{1d} = P_{ie} - R_s + (S/I)_T \tag{6}$$

where

P_{1d} = the degradation level relative to the threshold of the degradation in dB

R_s = the sensitivity of the receiver in dBm

$(S/I)_T$ = the threshold input signal-to-interference ratio, in dB, required to prevent degradation.

If the desired signal is at a level other than R_s, the actual level may be substituted for R_s. If Equations 5 and 6 are combined:

$$P_{1d} = P_T + G_T + G_R - L_P - L_f + (S/I)_T - R_s \tag{7}$$

where all of the terms have been defined.

If P_{1d} is greater than zero, degradation is expected to occur; conversely, if P_{1d} is less than zero, degradation is not expected and no further consideration need be given to interactions between the particular transmitter and receiver involved. Each of the terms in Equation 7 is discussed below.

Transmitted Power, P_T (dBm)

This parameter is a required input to the program and represents the average output power for communications transmitters and the peak output power for pulsed transmitters. This information can be obtained from either of the AVPAK 3 data bases (AVBASE, or AVFILE) or it may be provided by the user.

Antenna Gains, G_T, G_R (dBi)

AVPAK 3 has the capability of utilizing either user-supplied antenna gains or calculated gains determined by automated antenna gain subroutines which, for different arrays, determine the expected gain to be realized along the propagation path between the antennas on the airframe. For aperture antennas, gain routines were developed for three basic types: horn, circular aperture and rectangular array. These routines calculate far-field gain using aperture dimensions, transmitter frequency, and coupling angles referenced to the main beam axis. By calculating receiver antenna gain at the transmitter frequency (either fundamental or harmonic), out-of-band antenna responses are treated for aperture antennas. For non-aperture antennas, a nominal (2 dBi) gain is assigned.

The following material briefly describes some of the considerations in deriving antenna gain values, and the equations used.

The main beam gain of a circular aperture antenna is calculated in the program as:

$$G_{MB} = 20 \log D + 20 \log F - 52.6 \quad (8)$$

where

G_{MB} = main beam gain in dBi

D = diameter of aperture in feet

F = frequency in MHz.

Sidelobe gain is determined by using a Bessel envelope calculation.

The main beam gain for a rectangular aperture antenna is calculated from:

$$G_{MB} = 10 \log (LX \times LY) + 20 \log F - 51.6 \quad (9)$$

where

LX and LY = aperture dimensions in feet

F = frequency in MHz.

Sidelobe gain is determined from a sinX/X envelope calculation.[7]

[7]Kraus, J. D., *Antennas*, McGraw-Hill, New York, 1950.

The main beam gain for an optimum horn is calculated from:

$$G_{MB} = 8.08 + 10 \log (LA \times LB)/\lambda^2 \qquad (10)$$

where

LA and LB = aperture dimensions in inches

λ = wavelength in inches.

Sidelobe levels for an optimum horn are determined from look-up tables in the program. The method for computing these levels was obtained from Jasik.[8]

For all antenna types, backlobe gain is constant and equal to the value of the gain envelope at the 90° pattern point. All gains are idealized far-field values. Pattern perturbations which may be caused by the airframe are not considered.

Polarization mismatches are applied only to cross-polarized non-aperture antennas (i.e., for vertical-to-horizontal polarization or vice versa). Polarization mismatches are not applied to aperture antennas in the program, since this correction is appropriate for main beam coupling only, a condition which rarely occurs. When appropriate, up to 20 dB of loss can be manually applied to the results for cross-polarized main beam-coupled antennas. Mismatches for circularly or linearly (45°) polarized antennas to vertically or horizontally polarized antennas, (or vice versa) are not treated in the program. When necessary a 3-dB loss may be manually applied to the results of such a configuration.

Cosite Path Loss, L_P

The path loss between isotropic radiators on an airframe is calculated using the technique reported by Hasserjian and Ishimaru[9] and extended by Khan, et al.[10] These efforts have shown that the path loss along a conducting curved surface can be calculated by:

[8] Jasik, H., ed., *Antenna Engineering Handbook,* McGraw-Hill, New York, 1961.

[9] Hasserjian, G., and Ishimaru, A., *Excitation of a Conducting Cylindrical Surface of Large Radius of Curvature,* IRE Transactions on Antennas and Propagation, Vol AP-10, May 1962.

[10] Khan, P. J., et al, *Derivation of Aerospace Antenna Coupling Factor Interference Prediction Techniques,* Colley Electronics Laboratory, University of Michigan, 1964.

$$L_{PC} = L_{PF}\, F(y) \tag{11}$$

where

L_{PC} = the path loss along the curved surface of the airframe

L_{PF} = the path loss if the same surface were flattened into a plane

$F(y)$ = the loss factor due to the curvature of the surface i.e., the curvature factor.

The curvature factor $F(y)$ was expressed by Hasserjian, (Reference 9) in the form of two different infinite series as an approximate solution to Maxwell's equation with boundary conditions. One series expression was derived for "large values" of the parameter y and the other series was derived for "small values" of y. The numerical evaluation of these series for the magnitude of $F(y)$ versus y in decibels was done at the University of Michigan (Reference 10), and is presented as a tabulation of points of the graph of $F(y)$ versus y in Figure 3. This tabulation is used with an interpolation subroutine and the formula for y.

The independent variable, y, of this function is in itself a function of the "ray path" of length R_1 and of curvature ρ_1. The function y is:

$$y = (R_1)^{3/2} / \rho_1 \tag{12}$$

where

R_1 = the length of the curved ray path as normalized to the wave number, k (where $k = 2\pi/\lambda$, and λ is the wavelength). That is, $R_1 = k\, D_1$, where D_1 is the length of the curved ray path

ρ_1 = the curvature of the ray path as normalized by the wave number.

The value of y for a cylinder is determined from the following formula:

$$y = \frac{k^{\frac{1}{2}}\, a\phi^2}{[(\Delta Z)^2 + (a\phi)^2]^{\frac{1}{4}}} \tag{13}$$

where

a = the radius of the cylinder

ΔZ = the distance between the antennas along the axis of the cylinder

ϕ = the angle in radians between the antennas on a plane, defined by the two antennas and the center of the airframe.

The path loss between the antennas if the surface is assumed to be planar is calculated using the free-space formula:

$$L_{PF} = 20 \log f + 20 \log D_1 - 38 \qquad (14)$$

where

L_{PF} = the free-space loss between isotropic radiators in dB

f = the transmitted frequency in MHz

D_1 = the ray path distance along the surface between the antennas in feet.

The distance, D_1, for a cylinder is:

$$D_1 = [(\Delta Z)^2 + (a\phi)^2]^{\frac{1}{2}} \qquad (14a)$$

where all terms have been previously defined.

One of the restrictions in the technical development of the curvature factor is a requirement that the curvature along the ray path between the antennas remain constant. If the antennas lie on a conical surface, the requirement is not completely satisfied. In practical airframes, however, it can be shown that the ray path length can be calculated with a high degree of accuracy by treating the cone as a modified cylinder with a radius equal to the geometric mean of the radii of the cone at the locations of the antennas. The limitation of this approximation is that the apex angle of the cone can not exceed 20 degrees.

It can be shown that the curvature factor between two antennas on a cone lies between the two F(y)'s which would be calculated if the cone was replaced by two different cylinders having radii equal to the cone radii at each of the two antenna locations.

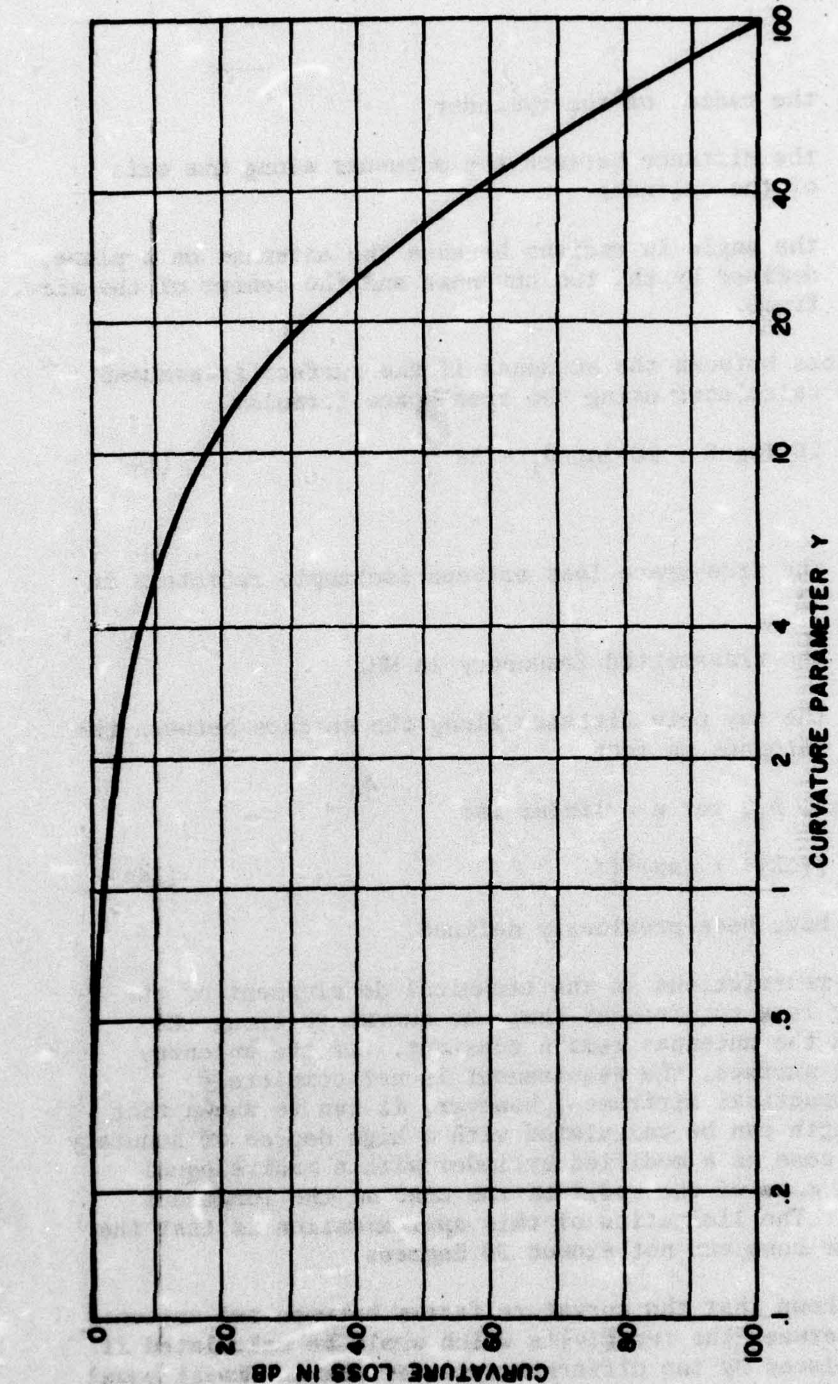


Figure 3. Plot of the function F(y), describing the magnitude of the curvature loss contribution corresponding to the calculated value of parameter y.

The remaining restrictions which affect the application of this technique include geometrical limitations which insure that the respective antennas do not lie within each other's Fresnel (near-field) region. These geometrical restrictions place a lower limit on the frequencies at which the coupling loss can be calculated. For example, if an HF wire antenna, the resulting radiating high frequency wavelengths, and an airframe length are all of comparable magnitudes, then the entire airframe can be expected to be a part of the HF antenna system. Any consideration of the coupling loss to be expected along the airframe, consequently, becomes an intra-antenna (near-field) consideration. Thus, this technique cannot be applied to HF systems.

In addition to the parameters discussed above, other factors must be considered for certain paths between antennas on an airframe. When one antenna is located in front of the metal nose bulkhead and the other is behind the bulkhead, a knife-edge diffraction loss can be expected due to the obstruction created by the bulkhead. Bullington presents a nomograph which can be used to calculate these losses (Reference 8, Chapter 33). This nomograph has been automated in equation form and this additional loss factor is automatically included when the transmission path crosses the nose bulkhead. The equation used is:

$$L_k = 10 \log (h^2 f/20d) \quad (15)$$

where

L_k = the knife-edge diffraction loss, in dB

h = the height of the obstruction above the straight-line path, in feet

f = the transmitted frequency, in megahertz

d = the distance between the bulkhead and the antenna nearest the bulkhead, in feet.

Another situation which must be considered occurs when the path between antennas is obstructed by an airfoil. A quasi-empirical equation has been developed at ECAC which calculates the coupling loss of an airfoil-obstructed path by determining the minimum free-space loss around the obstruction and adding a curvature loss over the minimum-distance path between antennas (through the airfoil).

$$L_W = 20 \log f + 20 \log D - 38 + F(y) \quad (16)$$

where

L_W = wing obstruction loss in dB

f = transmitted frequency in MHz

D = minimum distance around wing in feet

F(y) = previously discussed curvature factor whose ray path distance neglects the presence of a wing (see Section 2 for additional development of wing-obstructed coupling loss).

AVPAK 3 can also handle transmitters or receivers (or points, if a power density calculation is desired) that are raised from the fuselage; raised is defined as not lying on the fuselage skin. AVPAK 3 will calculate coupling loss for the following configurations:

1. Both antennas lie on the fuselage.
2. Both antennas are raised from the fuselage.
3. Antenna 1 is raised from the fuselage, antenna 2 lies on the fuselage.
4. The path between antenna 1 and antenna 2 is obstructed by an airfoil.
5. Antenna 1 lies on the fuselage, antenna 2 lies on a wing pod.
6. Antenna 1 is raised from the fuselage, antenna 2 lies on a wing pod.

Intersite Path Loss

For intersite analysis the path loss is calculated using the smooth curve-smooth earth (SCSE) model which is part of ECAC's master propagation calculation system. The entire airframe is assumed to be a radiator; hence, the individual bulkhead, curvature, and wing-shading losses associated with the cosite path are assumed to be negligible. The SCSE model[11] assumes a smooth spherical earth with a 4/3 radius of earth curvature. The model is valid for frequencies in the 50 MHz-to-12 GHz range and is applicable for antenna heights of great altitudes.

SCSE computes the basic median far-field path loss between isotropic radiators, using effective antenna heights at the two site locations. The model automatically selects the appropriate propagation region to be analyzed: reflection, intermediate, or diffraction. If antenna heights are greater than 3,000 feet, which is usually the case for an aircraft in flight, a preprocessor of

[11] Leggett, Robert and Madison, James, *Propagation User's Manual*, ECAC-UM-74-001, ECAC, Annapolis, MD, July 1974.

the model calculates a ray-trace correction along with the effective earth modeling. Additional information about the SCSE model may be found in Reference 11.

In an intersite analysis it is possible to have an aircraft-to-satellite situation, where the aircraft has a flight altitude of less than 100,000 feet (approximately 19 statute miles) and the satellite an altitude greater than 1,550,000 feet (approximately 294 statute miles). In a case such as this, an alternative approach to SCSE is used.

The geometry of the aircraft-to-satellite analysis situation is shown in Figure 4. The initial points and distances used are:

A. location of aircraft in flight (< 100,000 feet) approximated to be on the earth's surface relative to the altitude of the satellite.

B. location of the satellite.

C. center of the earth.

E. point on the earth's surface on the line BC.

S. ground distance (Great Circle) from A to E along the surface of the earth.

CE. approximate radius of the earth, (3963.0 statute miles).

BE. altitude of the satellite (>> 1,550,000 feet).

For the aircraft-to-satellite case, BE is usually much greater than 1,550,000 feet. Because of this, the altitude of the aircraft in flight (while in fact some height less than 100,000 feet) may be approximated as 0 feet. If the altitude of the aircraft is assumed to be 0 feet, then the aircraft lies on the curve S along the surface of the earth.

Let BE represent the altitude of the satellite. If the segment S is less than or equal to 500 statute miles then the path loss is calculated by:

$$L_p = 20 \log (f) + 20 \log (BE) + 37.0 \tag{17}$$

where

L_p = path loss between points A and B, in dB

f = transmitter frequency, in MHz

BE = altitude of the satellite, in statute miles, and BE ≃ BA

Figure 4. Aircraft-to-satellite analysis geometry. A segment of the earth's surface between A and E is represented by the curved line S. Point A is the aircraft in flight, which, relative to the satellite at point B, can be approximated to lie on line S.

This is the free-space loss equation for a line-of-sight case, which is valid when S is less than or equal to 500 statute miles.

If the segment S is greater than 500 statute miles, it must be determined whether the two sites are within line-of-sight of each other. This particular analysis will treat only line-of-sight cases. A detailed analysis may be found in Reference 12. If point E is found to be beyond line of sight from point A, the run is aborted. If not, L_p is calculated by the free-space loss equation with a more accurate representation of the distance between the sites AE, than is used in Equation 17 (Reference 11).

Receiver Rejection, L_f

The rejection offered to an undesired emission by a potential victim receiver is calculated by a programmed package known as the Frequency Analysis System (FAS). The following explanation of FAS will enable the reader to understand the operation of FAS and will prepare him for the more detailed description, including the mathematical approach, contained in the documentation of the model.[13]

For a given transmitter-receiver pair, FAS synthesizes the receiver response characteristic and the transmitter spectral emission characteristic by a series on line segments which are linear on a logarithmic scale. Each of these synthesized models is normalized to unity at the tuned frequency of the equipment such that the characteristics described are relative to the performance at the tuned frequency. The FAS synthesis does not include nonlinear effects. When this synthesis is complete, FAS determines the rejection by integrating over the areas of frequency overlap between the transmitted emission and the receiver response. Two cases are considered. The first case examined involves a calculation of the relative energy transfer to be expected due to the emission sidebands which lie within the passband of the receiver. The second case examined is the expected energy transfer resulting from inadequate receiver selectivity at the frequencies within the fundamental emission bandwidth of the transmitter. These

[12]Haseltine, R., *Avionics Interference Prediction Model (AVPAK)*, ECAC-TN-75-020, ECAC, Annapolis, MD, September 1975.

[13]Cleaver, R. and Bode, T., *An Algorithm for Calculating Transmitter-Receiver Frequency Rejection Loss*, ESD-TR-70-128, ECAC, Annapolis, MD, 1970.

two cases are compared and the worst situation, i.e. the least amount of rejection, is chosen as the appropriate rejection for the given equipment pair.

Receiver Response Synthesis. In the FAS model, the receiver relative response characteristic is synthesized by four line segments, which are linear on a logarithmic scale, and appear as shown in Figure 5. The variables are defined below.

f_R = the tuned frequency of the receiver

B_r = the intermediate frequency (IF) bandwidth of the receiver

n_1 = a factor used to describe the IF selectivity curve

N_1 = the slope of the IF selectivity skirt in dB per decade ($N_1 = 10\ n_1$)

f_1, f_2 = the lower and upper frequencies, respectively, where spurious responses must be considered. These frequencies should be selected to coincide with the intersection of the K_s level with the IF selectivity curve

K_s = the spurious response rejection of the receiver

f_a, f_b = the lower and upper frequencies, respectively, at which spurious responses need no longer be considered. These frequencies should be selected to coincide with the intersection of the K_s level with the RF circuitry selectivity curve

n_2 = a factor describing the slope of the RF selectivity curve

N_2 = the slope of the RF selectivity skirt in dB per decade ($N_2 = 10\ n_2$).

The normalized response characteristic may be expressed mathematically as:

$$r(f) = 1, \text{ when } \left(f_R - \frac{B_r}{2}\right) < f < \left(f_R + \frac{B_r}{2}\right) \qquad (18a)$$

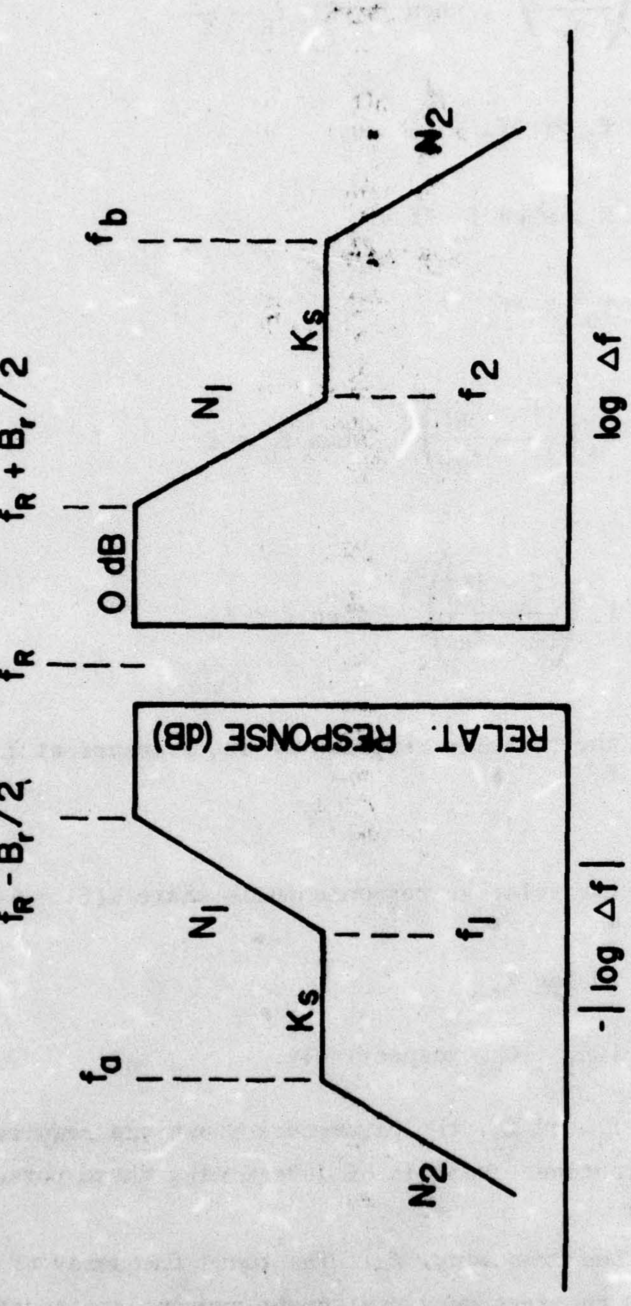


Figure 5. Receiver relative-response characteristic.

$$r(f) = \left(\frac{\frac{B_r}{2}}{f-f_R}\right)^{n_1}, \text{ when } f_1 < f < f_R - \frac{B_r}{2} \tag{18b}$$

$$\text{or } f_2 > f > f_R + \frac{B_r}{2}$$

$$r(f) = k_s, \text{ when } f_a < f < f_1 \tag{18c}$$

$$\text{or } f_b > f > f_2$$

$$r(f) = k_s \left(\frac{|f - f_b|}{|f - f_R|}\right)^{n_2}, \text{ when } f_b < f \tag{18d}$$

$$r(f) = k_s \left(\frac{|f - f_a|}{|f - f_R|}\right)^{n_2}, \text{ when } f < f_a \tag{18e}$$

where

$r(f)$ = the relative response of the receiver at frequency f.

Then

$R(f)$ = the relative response in dB where $R(f) = 10 \log r(f)$, and

K_s = $10 \log k_s$.

N_1, N_2 = $10n_1, 10n_2$ respectively.

Except for f_1 and f_2, the parameters shown are required inputs for the FAS subroutine. Methods of determining these parameters are explained below.

Receiver Tuned Frequency, f_R. The tuned frequency of the receiver is obtained from the frequency assignment appropriate to the receiver being considered, and is a required input to the FAS program.

IF Bandwidth, B_r. The intermediate frequency bandwidth is obtained from the nominal characteristics of the receiver, usually set forth in the manufacturer's data in technical manuals describing the equipment, or it is obtained from measured data. It is a required input and must have a value greater than zero.

IF Skirt Slope, N_1. This parameter is extracted from the given IF selectivity characteristics. It is the slope of the skirt in dB per decade. For example, the nominal characteristics of a receiver may specify that the IF selectivity of a receiver has a 20-dB bandwidth of BW_1 and a 60-dB bandwidth of BW_2.

Then n_1 is obtained from:

$$(60\text{-}20)\text{dB} = 40 \text{ dB} = 10n_1 \log \frac{BW_2}{BW_1} \tag{19a}$$

and

$$N_1 = \frac{40}{\left(\log \frac{BW_2}{BW_1}\right)} \tag{19b}$$

This is a required input and must be greater than zero.

RF Skirt Slope, N_2. Characteristics of the RF circuitry, which must usually be theoretically synthesized, can be found in AVBASE, the AVPAK file of selected avionics equipment. The determination of these characteristics is the result of special analysis intended to study such characteristics. There are two methods for synthesizing RF selectivity.

The first method requires information concerning the receiver design, i.e., the number of tuned circuits preceding the first mixer in a receiver. This information can be obtained by examination of the circuit diagrams included in the technical manual describing the equipment. When the number of tuned circuits is known, the relative response of the circuity can be calculated from the following equation:

$$R_{RF} = 20 \log \left[1 + \left(\frac{2\,|f - f_R|}{f_R} Q_s\right)^2\right]^{-n/2} \tag{20a}$$

or

$$R_{RF} = -10n \log \left[1 + \left(\frac{2\,|f - f_R|}{f_R} Q_s\right)^2\right] \quad (20b)$$

where

R_{RF} = the RF response in dB relative to the response at the tuned frequency of the receiver

n = the number of tuned circuits preceding the first mixer

f = the frequency at which the relative response is required

f_R = the tuned frequency of the receiver

Q_s = the selectivity factor of each tuned stage, defined by

$$Q_s = \frac{f_R}{2\,|f - f_R|_{3\ dB}} \quad (21)$$

where

$2\,|f - f_R|_{3\ dB}$ = the 3 dB bandwidth of the stage.

The parameter Q_s is not generally available and must be estimated. An estimated Q_s of 50 yields sufficiently conservative results for most analyses.

The solution of Equation 20 as a function of frequency will yield the relative selectivity of the RF circuitry of the receiver.

In certain cases, the number of tuned circuits preceding the mixer is unknown but the RF 3-dB bandwidth is specified along with the image rejection. When these parameters are given, an alternate method for estimating the RF characteristics can be used.

The parameter N_2 is equivalent to $10n_2$, which equals 20n, where n is the number of RF tuned circuits, or $N_2 = 10n_2 = 20$ n.

The image frequency of a receiver is separated from the tuned frequency by twice the intermediate frequency. If an "image bandwidth" is defined as equal to four times the intermediate frequency, i.e., twice the image frequency separation from the tuned frequency, then the parameter N_2 can be approximated by:

$$K_1 - 3\text{ dB} \cong 10\, n_2 \log\left(\frac{BW_I}{BW_{3\text{ dB}}}\right) \text{ or,} \tag{22a}$$

$$N_{2a} \cong \frac{K_1 - 3\text{ dB}}{\log\left(\frac{BW_I}{BW_{3\text{ dB}}}\right)} \tag{22b}$$

where

N_{2a} = the approximate value of N_2

K_1 = the image rejection in dB

BW_I = the "image bandwidth" defined above (note that this bandwidth is a mathematical device and not a physical reality)

$BW_{3\text{ dB}}$ = the specified 3-dB RF bandwidth of the receiver.

The model does not accommodate receivers with variable-tuned intermediate frequencies.

It should be noted that the universal resonance curve, when plotted on a logarithmic scale, is rounded rather than linear in the vicinity of the 3-dB bandwidth. Therefore, the value of N_{2a} obtained from Equation 22b will be slightly larger than is appropriate. Therefore, this value should be rounded off to the nearest multiple of 20 which is less than that value. Thus, $N_2 = N_{2a}$ rounded down to the nearest multiple of 20. When this value of N_2 is determined, then n, the number of stages, is obtained by dividing by 20. A corresponding value of Q_s for the RF circuitry can then be calculated by:

$$Q_s = Q_o\left(2^{1/n} - 1\right)^{\frac{1}{2}} \tag{23}$$

where

Q_s = the effective selectivity factor for each tuned circuit preceding the mixer

Q_o = the overall selectivity factor for the n tuned circuits

n = the number of tuned circuits as determined above.

The computation of the two parameters, Q_s and n, results in values which can be used in Equation 20 to estimate the RF selectivity characteristics of the receiver.

If neither of these alternatives is feasible due to a lack of information, the preprocessor will assign a worst-case (i.e. interference susceptible) recovery value of 20 dB/decade.

Spurious Response Rejection, K_s. The minimum spurious response rejection is usually specified in the nominal characteristics of the receiver. If not, a worst-case rejection level can be estimated in the following manner. Spurious responses arise in a superheterodyne receiver when a high level interfering signal combines in the mixer circuitry and a product at or near the intermediate frequency of the receiver is generated. In general, the most sensitive of these responses arises due to the mixing of the incoming signal and the first local oscillator frequency in the first mixer stage. The frequencies at which the interfering signal can excite these responses is given by:

$$f_{sp} = \frac{pf_{lo} \pm f_{IF}}{q} \tag{24}$$

where

f_{sp} = the frequency of the incoming interfering signal

f_{lo} = the injection frequency of the local oscillator

f_{IF} = the intermediate frequency of the receiver

p = the harmonic of the local oscillator involved in the mix

q = the harmonic of the incoming signal involved in the mix.

The fact that the sign preceding f_{IF} in Equation 24 can take on either sense (±) indicates that for a given p,q combination, a pair of responses can be predicted, one for the negative sense and one for the positive sense. In a superheterodyne receiver, the local oscillator frequency, f_{lo}, is related to the tuned frequency, f_R, as follows:

$$f_{lo} = f_R \pm f_{IF} \tag{25}$$

where the positive sense is appropriate when the oscillator frequency is above the tuned frequency and the negative sense is appropriate when the reverse situation occurs.

The combination of Equations 24 and 25 yields two sets of relationships:

$$\left. \begin{array}{l} f_{sp} = \dfrac{pf_R}{q} + \dfrac{(p+1)\ f_{IF}}{q} \\ \text{and} \\ \dfrac{pf_R}{q} + \dfrac{(p-1)\ f_{IF}}{q} \end{array} \right\} \text{when } f_{lo} > f_R \tag{26a}$$

and

$$\left. \begin{array}{l} f_{sp} = \dfrac{pf_R}{q} - \dfrac{(p+1)\ f_{IF}}{q} \\ \text{and} \\ \dfrac{pf_R}{q} - \dfrac{(p-1)\ f_{IF}}{q} \end{array} \right\} \text{when } f_R > f_{lo} \tag{26b}$$

These expressions enable a determination of the frequencies at which an incoming signal can result in the most sensitive spurious responses. Note that when p=q=1, the two responses which result are the receiver response to its tuned frequency and the response to its image frequency. The relative rejection at the tuned frequency is zero and, from the previous discussion, it is known that the relative rejection at the image frequency is merely the RF rejection at that frequency.

The relative spurious rejection for any other p,q combination is the product of the RF rejection at the incoming frequency, f_{sp}, and the relative mixer conversion loss for the p,q combination being studied. This can be expressed logarithmically as:

$$K_s = R_{RF} + \mu_c \tag{27}$$

where

K_s = the relative spurious rejection in dB

R_{RF} = the relative rejection of the RF circuits at f_{sp} in dB

μ_c = the mixer conversion loss of the actual p,q combination relative to the mixer conversion loss of the p=q=1 combination.

In a previous ECAC measurement effort the relative mixer conversion losses for transistor mixers were established. These values, which are representative of most mixers, are shown in TABLE 1.

TABLE 1

RELATIVE TRANSISTOR MIXER CONVERSION LOSS IN dB

p \ q	1	2	3	4	5
1	0	-65	-76	-84	-83
2	-13	-58	-77	-83	-83
3	-13	-65	-77	-81	-82
4	-20	-62	-81	-81	-82
5	-22	-62	-78	-84	-82

The relative spurious rejection level obtained with Equation 27 for the most susceptible response, excluding the image response, is the value which should be used as an input to the program. If an input is not given, a nominal value for K_s of 60 dB is assigned by the preprocessor. The image rejection will also be assigned a

nominal value of 60 dB if no value is given, but the image response is treated as a special case. When this situation does arise, the receiver is synthesized around the image frequency in an identical manner to the synthesis about the tuned frequency, except that the relative threshold is reduced by the input image rejection.

Spurious Response Limit Frequencies, f_a, f_b. As stated previously, these frequencies are determined from the point where the K_s level intersects the RF selectivity curve. It should be noted, however, that f_a and f_b are discrete frequencies, rather than frequency separations. Since the RF selectivity is usually specified in terms of response versus frequency separation, the intersection point is more readily obtained in terms of a frequency separation. It is necessary, therefore, to add this separation to (or subtract it from) the receiver tuned frequency to obtain the appropriate values of f_a and f_b. If discrete frequencies for f_a and f_b are not entered into the program, recovery values will be assigned by the preprocessor. For the fixed-tuned case, upper and lower recovery values are determined by $f_r \pm 2IF$. For the range-tuned case, the lower value is the lower limit of the range less 2IF and the upper limit is the upper limit plus 2IF.

Transmitter Spectral Emission Synthesis

The envelope of the spectral characteristics of a transmitter is synthesized by three line segments which are linear on a logarithmic scale as shown in Figure 6.

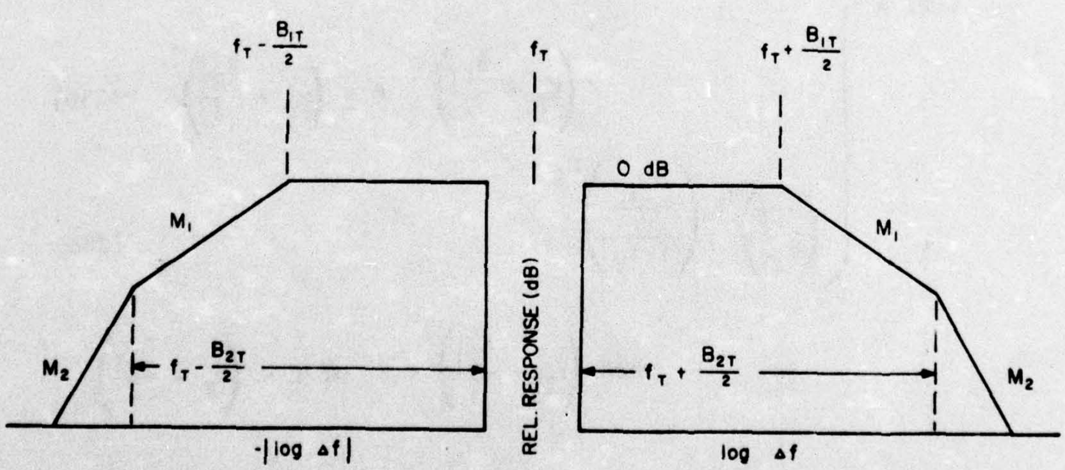


Figure 6. Relative spectral emission envelope characteristic.

The parameters shown in Figure 6 are identified as:

f_T = the tuned frequency of the transmitter

B_{1T} = the 3 dB emission bandwidth

M_1 = $10m_1$ = the slope of the emission envelope at frequencies adjacent to the 3 dB bandwidth in dB/decade

B_{2T} = the emission bandwidth at which the envelope shows a different fall-off characteristic

M_2 = $10m_2$ = the slope of the emission envelope at frequencies greatly separated from the tuned frequency in dB/decade.

The emission characteristic may be expressed mathematically as:

$$t(f) = \begin{cases} 1, & \text{when } \left(f_T - \frac{B_{1T}}{2}\right) < f < \left(f_T + \frac{B_{1T}}{2}\right) \quad \text{(28a)} \\ \left(\dfrac{\frac{B_{1T}}{2}}{|f-f_T|}\right)^{m_1}, & \text{when } \left(f_T - \frac{B_{2T}}{2}\right) \leq f < \left(f_T - \frac{B_{1T}}{2}\right) \\ & \text{or} \\ & \left(f_T + \frac{B_{1T}}{2}\right) < f \leq \left(f_T + \frac{B_{2T}}{2}\right) \quad \text{(28b)} \\ \left(\dfrac{B_{1T}}{B_{2T}}\right)^{m_1} \left(\dfrac{\frac{B_{2T}}{2}}{|f-f_T|}\right)^{m_2}, & \quad \text{(28c)} \\ & \text{when } \left(f_T + \frac{B_{2T}}{2}\right) < f \text{ or } f < \left(f_T - \frac{B_{2T}}{2}\right) \end{cases}$$

where

$t(f)$ = the relative level of the spectral emission envelope at frequency f; and,

$T(f)$ = 10 log t(f), the relative level in decibels.

Each of the transmitter parameters is discussed below.

Communications Transmitters. The inputs to enable synthesis of the spectral envelope of communications transmitters are:

B_{1T} = The emission envelope bandwidth of the first breakpoints is the nominal 3-dB bandwidth. This item has a missing input recovery mode made up of the FCC emission designator and pulse characteristics derived from the pulse compression indicator, pulsewidth, and pulse rise and fall times, which are all required inputs. The FCC Emission Designator is made up of the bandwidth containing 99% of the mean radiated power and the modulation type used.

M_1 = The first slope fall off of the emission envelope; it is the slope adjacent to the 3-dB bandwidth. *The value given must be* $\geq$ *20 dB/decade.* This item has a missing input recovery mode similar to B_{1T}.

B_{2T} = This is the emission envelope bandwidth of the second breakpoints; it is the bandwidth at which the envelope shows a second fall-off characteristic. This item has a missing input recovery mode similar to B_{1T}.

M_2 = This is the second slope fall off of the emission envelope; it is the slope at frequencies greatly separated from the tuned frequency. The value used must be $\geq$ 40 dB/decade. This item has a missing input recovery mode similar to B_{1T}.

The specification of the minimum 20 dB/decade for M_2 represents the expected minimum fall-off characteristic of the noise sidebands of these transmitters. If an external RF filter is used in conjunction with the transmitter, the fall-off characteristic of the filter should be added to M_2.

Pulsed Transmitters. Inputs for pulsed transmitters can be categorized into two cases, pulsed transmitters without frequency modulation during the pulse interval (P0 emission), and pulsed transmitters with frequency modulation during the pulse interval, i.e. "chirped" pulsed (P9 emission). If the pulsed transmitter concerned has a P0 emission, the pulse width (τ) entered should be the width at the half-amplitude points. If the emission is P9, the τ entered should be the "stretched" pulse width or total duration of the pulse.

For P0 emissions, the spectral envelope can be found using the methods described by Mason and Zimmerman.[14] The results are:

$$B_{1T} = 1.28/(2\tau + t_r + t_f) \tag{29a}$$

$$M_1 \geq 20 \text{ dB/decade}$$

$$B_{2T} = 0.32 \left(\frac{1}{t_r} + \frac{1}{t_f}\right) \tag{29b}$$

$$M_2 \geq 40 \text{ dB/decade}$$

where

τ = the pulse width between one-half amplitude points

t_r = the time required for the pulse to rise from its 10 percent amplitude point to its 90 percent amplitude point, i.e., the pulse rise time

t_f = the time required for the pulse to drop from its 90 percent level to its 10 percent level, i.e., the pulse fall time.

The parameter τ is a required input and can be obtained from the nominal characteristics of the equipment. The parameters B_{1T}, B_{2T}, M_1, M_2, t_r, and t_f all have missing-input recovery modes.

The determination of the envelope parameters of a chirped pulse can be quite complex[15] and the resulting emission spectral

[14] Mason, S. and Zimmerman, H., *Electronic Circuits, Signals, and Systems*, John Wiley and Sons, New York, 1960.

[15] Klauder, J. R. et al., *The Theory and Design of Chirp Radars*, The Bell System Technical Journal, July 1960.

envelope for such a pulse is not always amenable to a three-line-segment synthesis technique. However, for most practical cases the inputs can be determined as:

$$B_{1T} = f_d \left[1 - \left(\frac{2}{D}\right)^{\frac{1}{2}}\right] \tag{30a}$$

where

f_d = the total frequency deviation during the pulse

D = the dispersion ratio = τf_d where τ is the total duration of the pulse.

$$B_{2T} = f_d \left[1 + \left(\frac{2}{D}\right)^{\frac{1}{2}}\right] \tag{30b}$$

and

M_1 = the slope of the line in dB/decade which joins the points $\frac{B_{1T}}{2}$ and $\frac{B_{2T}}{2}$ when those points are plotted on a logarithmic scale

M_2 = second slope fall-off of the emission envelope. The value used must be $\geq$ 20 dB/decade.

The inputs B_{1T}, B_{2T}, M_1, and M_2 have missing-input recovery modes.

Harmonic Emissions. In addition to synthesizing the envelope of the spectral characteristicsof the fundamental emission of the transmitter, the model automatically synthesizes the spectral envelopes of the transmitted harmonics up to a maximum of the ninth harmonic. In doing so, the subroutine assumes that the spectral characteristics of each harmonic are identical to that of the fundamental except that the reference point is reduced by a level in dB equal to the attenuation specified as appropriate to the harmonic. Attenuation levels for all harmonics to be considered (up to the ninth) are required input parameters.

Rejection Calculation

After the receiver-response and spectral-emission characteristics have been synthesized, and each has been normalized to the level appropriate at the tuned frequency of the equipment, the expected

rejection offered by the receiver to the undesired emission can be calculated using only frequency relationships. The development of this concept is given below.

The spectral power density of an emission can be approximated by:

$$P_D = \frac{P_T}{B_{1T}} \tag{31}$$

where

P_D = the spectral density in watts/Hz

P_T = the average transmitter power in watts

B_{1T} = the 3-dB emission bandwidth in Hz.

Thus P_D represents an approximation to the average energy content in the emission. However, the receiver can only intercept that energy for a period of time equal to its "response time". The "response time", τ_R, of a receiver can be considered to be the inverse of its 3-dB bandwidth. Accordingly, the maximum power transfer between a transmitter and receiver can be calculated by:

$$P_r = \frac{P_D}{\tau_R} = \frac{P_T}{B_{1T}\,(\tau_R)} = P_T\,\frac{B_R}{B_{1T}} \tag{32}$$

where

P_r = the average received power in watts

B_r = the 3-dB bandwidth of the receiver.

The receiver rejection, l_f, is the ratio of the received power to the transmitted power:

$$l_f = \frac{P_r}{P_T} = \frac{B_R}{B_{1T}} \text{ or in logarithmic terms,} \tag{33}$$

$$L_f = 10 \log l_f = 10 \log \frac{B_R}{B_{1T}}$$

The maximum power transfer occurs when the transmitter and receiver are tuned to the same frequency. Therefore, a cochannel *rejection* factor $(1_f)_{co}$ can be defined as:

$$(1_f)_{co} = \frac{B_R}{B_{1T}} \text{ when } B_{1T} > B_R \tag{34}$$

and

$$1, \text{ when } B_{1T} \leq B_R$$

The reason for the two cases is evident when it is remembered that a receiver cannot receive more power than is transmitted.

It should be noted, however, that the cochannel rejection factor in Equation 34 has been defined in terms of average power. When the undesired emission is from a pulsed transmitter, the peak received power is usually of more interest than the average received power. Thus for a pulsed transmitter:

$$(P_T)_{avg} = (P_T)_{pk}\, \tau\, (PRF) \tag{35}$$

where

$(P_T)_{avg}$ = the average power in watts

$(P_T)_{pk}$ = the peak power in watts

τ = the pulse duration in seconds

PRF = the pulse repetition frequency in hertz.

If Equation 35 is combined with Equation 32 then:

$$(P_R)_{avg} = (P_T)_{pk}\, \tau\, (PRF) \frac{B_R}{B_{1T}} \tag{36}$$

However, in a pulsed transmitter, $\tau \approx \frac{1}{B_{1T}}$, and the average received power $(P_R)_{avg}$ is related to the peak received power, $(P_R)_{pk}$, by:

$$(P_R)_{avg} = (P_R)_{pk}\, \tau_R\, PRF \tag{37}$$

where

τ_R = the response time of the receiver, which is approximately $\frac{1}{B_R}$.

Thus, combining Equation 37 with Equation 36 and defining a cochannel rejection factor for pulsed emissions, it is seen that:

$$(l_f)_{co} = \begin{cases} \left(\frac{B_R}{B_{1T}}\right)^2 & \text{, when } B_{1T} > B_R \\ \text{and} & \\ 1 & \text{, when } B_{1T} \leq B_r \end{cases} \qquad (38)$$

Equation 38 applies for considerations involving the peak power transfer due to a pulsed transmitter.

Since the cochannel rejection has been determined, the total rejection, L_f, at any frequency can be calculated by:

$$L_f = (L_f)_{co} + R(f_T), \qquad (39)$$

Equation 39 applies for considerations involving the power transfer resulting from the fundamental emission of the transmitter as affected by receiver selectivity.

Also,

$$L_f = (L_f)_{co} + T(f_R) \qquad (40)$$

applies for considerations involving the power transfer resulting from emission sidebands which occur within the receiver passband.

In Equations 39 and 40,

$R(f_T)$ = the relative response of the receiver at frequency f_T

$T(f_R)$ = the relative emission level of the transmitter at frequency f_R.

The FAS subroutine essentially calculates the value of L_f for each of the situations given above, compares the two values, and selects the lowest of the values obtained for use in Equation 7. However, since both the relative response characteristic of the receiver and the relative emission level of the transmitter can vary over a range of frequencies, the computation is made using integration techniques.

Further details on the subroutine, including a rigorous mathematical description of the calculation techniques, may be found in Reference 13.

Degradation Thresholds, $(S/I)_T$

The input signal-to-interference ratio at which operational degradation begins to occur in a receiver is defined as the degradation threshold, and is identified by the symbol $(S/I)_T$. It is the minimum signal-to-interference ratio corresponding to non-interference and may be obtained from equipment characteristics. If no ratio is given, a value of 20 dB is assigned by the preprocessor.

POWER DENSITY CALCULATION

The capability to predict power densities resulting from transmitters located on an airframe as well as from transmitters located on neighboring aircraft is one of the features AVPAK 3 provides.

The power density at a given point resulting from the operation of a single transmitter is calculated by:

$$P_D = P_T + G_T - L_p + 20 \log f - 38.5 \qquad (41)$$

where

P_D = power density level in dBm per square meter

P_T = transmitter output power in dBm

G_T = effective transmitter antenna gain in the direction of the point in dBm

L_p = coupling path loss between transmitting antenna and desired point in dB

f = the transmitting frequency in MHz.

This equation may vary for different transmitter modulation types. AVPAK 3 considers two different modulation types, pulsed and non-pulsed (continuous wave). For pulsed transmitters, (modulation type P9 or P0), both peak and average power densities are calculated. For non-pulsed transmitters an average power density is used. The revised power density expressions are:

$$P_{DPK} = P_{TPK} + G_T - L_p + 20 \log f - 38.5 \quad (42)$$

$$P_{DAVG} = P_{TAVG} + G_T - L_p + 20 \log f - 38.5 \quad (43)$$

where

P_{DPK} = the peak power density level in dBm per square meter

P_{DAVG} = the average power density level in dBm per square meter

P_{TPK} = peak transmitter output power in dBm

P_{TAVG} = average transmitter output power in dBm.

The transmitter output power for non-pulsed transmitters may be obtained from nominal characteristics or measured data. This value is assumed to be an average power level. For pulsed transmitters the output power, obtained in the same way, is assumed to be a peak power level. It is necessary to calculate the average power output level for pulsed transmitters. This is done using the following formula:

$$P_{tavg} = (P_{tpk}) (\tau) (PRF) \quad (44)$$

where

P_{tavg} = average transmitter output power in kilowatts

P_{tpk} = peak transmitter output power in kilowatts

τ = transmitter pulse width in seconds

PRF = transmitter pulse repetition frequency in pps.

AVPAK 3 also calculates the cumulative power density due to the effects of all transmitters at each point of interest, following the individual transmitter calculations. The cumulative power

density uses the average power densities so that both pulsed and non-pulsed transmitters are represented. It is calculated as:

$$P_{DSC} = 10 \log \sum_{i=1}^{n} 10^{\left[\frac{(P_{DAVG})_i}{10}\right]} \tag{45}$$

where

P_{DSC} = cumulative average power density due to all transmitters, at point of interest, dBm per square meter

n = number of individual transmitters in the environment

$P_{DAVG\ i}$ = average power density at point of interest due only to transmitter i in dBm/square meter.

The field may also be expressed in terms of the magnitude of the electric field vector in volts per meter. The conversion in the program is done thusly:

$$F_s = 10^{\left(\frac{P_D - 4.237}{20}\right)} \tag{46}$$

where

F_s = field strength in volts/meter

P_D = power density in dBm/square meter.

Both the power density and electric field strength are computed and printed. Note that field strength is computed for the case where P_D is equal to P_{DSC} (cumulative power). The value so computed is fictitious and could never be verified by direct measurement. It represents an equivalent field strength which, if produced by a single transmitter, would have the same effect as the sum of several discrete sources.

A conversion chart from dBm/m^2 to volts/meter is shown in Figure 7.

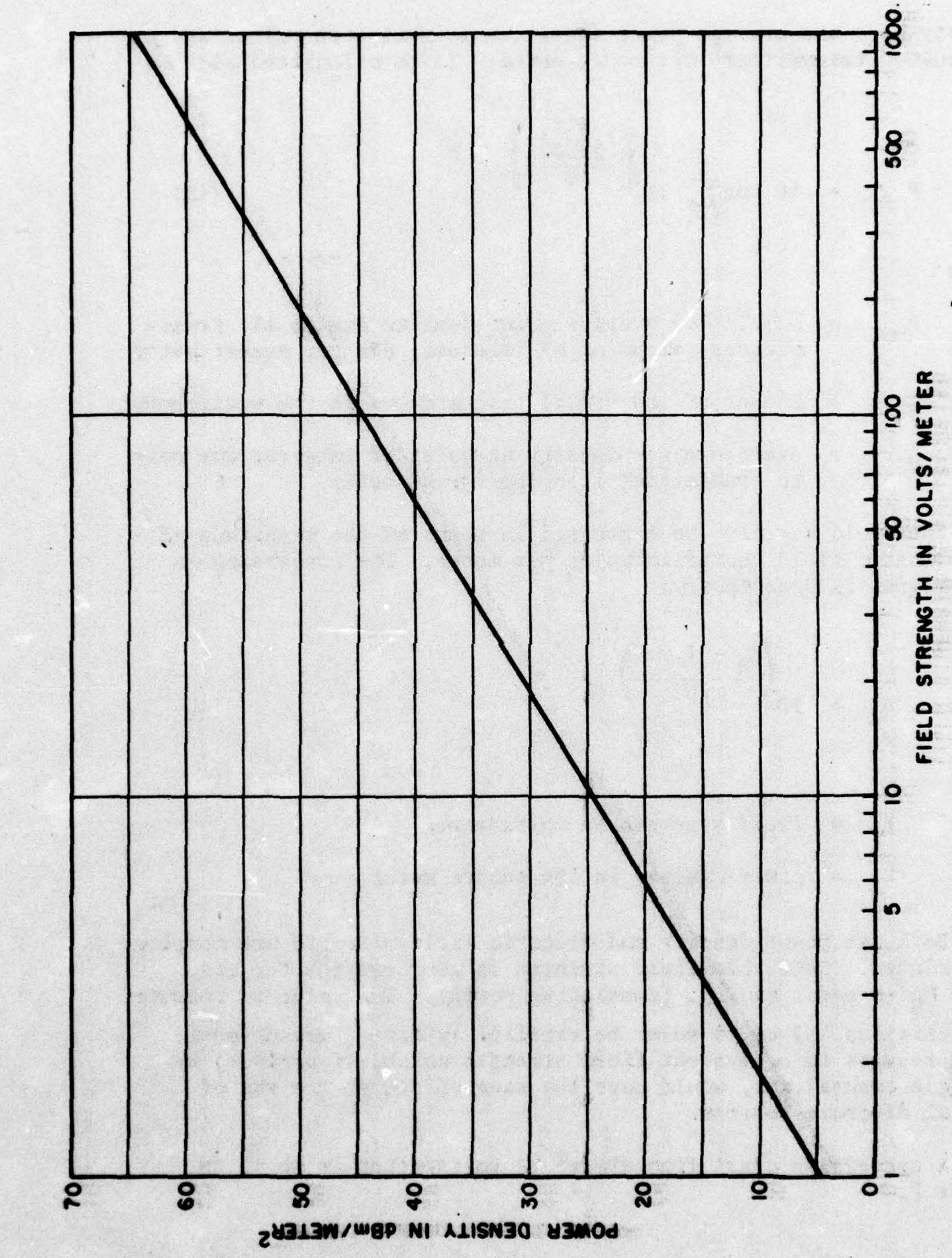


Figure 7. Conversion chart from power density in dBm/meter^2 to field strength in volts/meter.

Coordinate Systems

Coordinates for transmitters, receivers and points may be entered in the model by the user in rectangular (x,y,z) coordinates, cylindrical (ρ, θ, z) coordinates, or the buttline-waterline-fuselage station (B, W, F) coordinate system.

Regardless of what coordinate system is used, the location coordinates are converted in the model to the rectangular system.

Referring to Figure 8, in the rectangular coordinate system the origin is forward at the center of the fuselage with the positive X direction being to the right (starboard) side of the aircraft. The origin is in a similar location for the cylindrical coordinate system. In buttline-waterline-fuselage station coordinates the origin is forward, not at the center but at the bottom of the fuselage. The positive buttline is to the left (port) side of the aircraft, the waterline direction toward the top of the aircraft, and the fuselage station direction toward the tail of the aircraft.

OUTPUT TYPES

AVPAK 3 provides three ways of solving the basic interference expression to determine if degradation is to occur between a transmitter and a receiver. The three analysis types are deterministic, functional and probabilistic.

Deterministic Analysis

A deterministic analysis is performed in AVPAK 3 by considering specific transmitter/receiver pairs and evaluating the following equation:

$$P_{1d} = P_T + G_R + G_T - L_P + (S/I)_T - R_S \qquad (47)$$

where all terms have been previously defined.

If P_{1d} is greater than zero, then AVPAK 3 makes the prediction that interference to the receiver due to the transmitter will occur, and the particular equipment pair is entered in the list of potential interference cases. If P_{1d} is less than zero, the equipment pair is entered in the non-interference list.

The values of the terms in Equation 47 are based on nominal (generally median) equipment parameters. The user may either enter these equipment parameters or, by using a unique identification code,

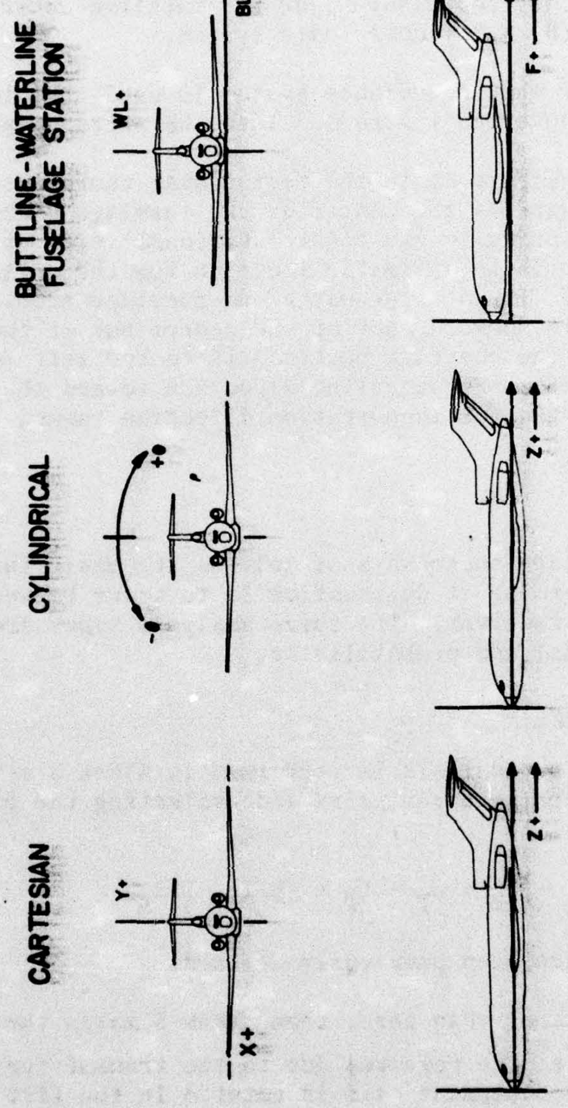


Figure 8. Coordinate systems that may be used to input data into AVPAK 3.

automatically retrieve the desired parameters from the AVPAK file AVBASE.

Functional Analysis

A functional analysis can be performed instead of a purely deterministic one. This type of analysis is identical to the deterministic type except a different data base, AVFILE is called upon for equipment parameter values. In AVFILE, equipments are grouped according to functional classes. A functional class is a group of equipments whose characteristics are similar enough so that all individual equipments in the group can be represented by a single representative equipment type. The parameter values which represent a single representative equipment type are the median values of the equipments making up the functional class.

Probabilistic Analysis

The third type of analysis, probabilistic, allows the transmitter/receiver pairs to be analyzed using statistical descriptions or cumulative distributions for the terms in Equation 47 whose expected errors from median values can be confidently described. In other words, median values for P_T (transmitter power) L_F (off-frequency rejection) L_P (path loss) and R_S (receiver sensitivity) may not be realistic enough to yield an accurate prediction of interference using a deterministic approach. The distributions for these parameters are stored along with the functional class data in AVFILE.

The median values for the terms in Equation 47 are denoted as $\overline{P}_T$, $\overline{L}_F$, $\overline{L}_P$, and $\overline{R}_S$. The expected variation of these median values are ϵ_{PT}, ϵ_{TOFR} and ϵ_{ROFR}, ϵ_{LP}, and ϵ_{RS}. ϵ_{TOFR} and ϵ_{ROFR} represent the variation in transmitter and receiver off-frequency rejection, respectively.

The probabilistic analysis begins with a procedure similar to the deterministic analysis. The following inequality is checked:

$$\overline{P}_{IN} + DU_T > \overline{R}_S \tag{48a}$$

where

$$\overline{P}_{IN} = \overline{P}_T + \overline{G}_T + \overline{G}_R - \overline{L}_P - \overline{L}_F + (S/I)_T \tag{48b}$$

$\vec{P}_{IN}$ = the effective median interference power for the functional classes being analyzed (dBm).

and

$\overline{R}_S$ = median receiver sensitivity

$$DU_T = \left[(DU_{PT})^2 + (DU_{LP})^2 + (DU_{TOFR})^2 + (DU_{ROFR})^2 + (DU_{RS})^2\right]^{\frac{1}{2}} \tag{48c}$$

where

DU_T = upper decile (90% probability) correction factor in dB made up of upper decile values determined from cumulative error distributions of P_T, L_P, L_F and R_S. The L_F factor is comprised of the contribution of the transmitter to the receiver off-frequency rejection (TOFR) cumulative error and the contribution of the receiver to the receiver rejection cumulative error (ROFR).

These upper decile values are determined from the cumulative error distribution plots of the respective equipment parameters at the 90% probability level.

If Expression 48a is not satisfied by an equipment pair, the pair is simply entered in the list of predicted non-interference cases.

If Expression 48a is found to be true for a given pair, the probabilistic analysis continues by statistically convolving the cumulative distribution of expected errors for each of the five factors. The convolved distribution for any particular equipment pair is determined as:

$$\varepsilon_T = \varepsilon_{PT} * \varepsilon_{TOFR} * \varepsilon_{ROFR} * \varepsilon_{LP} * \varepsilon_{RS} \tag{49}$$

where

ε_T = convolved cumulative error distribution function for the transmitter/receiver pair, expressed as dB error

ε_{PT} = convolved cumulative distribution of expected errors from the median value of transmitter power in dB

ε_{TOFR} = convolved cumulative distribution of expected errors from the median value of the transmitter contribution to the receiver off-frequency rejection, in dB

ε_{ROFR} = convolved cumulative distribution of expected errors from the median value of the receiver contribution to the receiver off-frequency rejection, in dB

ε_{LP} = convolved cumulative distribution of expected errors from the median value of path loss, in dB

ε_{RS} = convolved cumulative distribution of expected errors from the median value of receiver selectivity in dB.

The terms TOFR (transmitter contribution to receiver off-frequency rejection) and ROFR (receiver contribution to receiver off-frequency rejection) require additional development. Their values and associated deviations are obtained in the following manner. The distributions of TOFR and ROFR are assumed to be normal, and the median values for both terms are set equal to zero. The standard deviation of ROFR, σ_{ROFR}, is associated with the discrete spurious-response level, K_S, discussed previously under Receiver Rejection, page 31. When groupings of individual equipments were taken to form the functional classes, the median value and standard deviation of K_S was determined for each functional class. The value of σ_{ROFR} was set equal to the associated K_S value. A cumulative distribution of expected errors from the median value was then formed and convolved, yielding ε_{ROFR}. The standard deviation for TOFR, σ_{TOFR}, was determined through transmitter emission-envelope synthesis. For each transmitter functional class, the spectral emission envelope was modeled using median values. The standard deviations of the parameters used were known. The value of the appropriate σ was then added to the median value of the emission bandwidth (B_{2T}, defined on page 39) at which the envelope fall-off slope changes (i.e., $B_{2T} + \sigma_{B_{2T}}$). The vertical difference

between the envelope modeled using the median value of B_{2T} and the envelope modeled using $(B_{2T} + \sigma_{B_{2T}})$, at the beginning of the second slope, is one-half the value of σ_{TOFR}. It is one-half the value because the total variation about B_{2T} would also contain the area one sigma below B_{2T} (i.e., $B_{2T} - \sigma_{B_{2T}}$); because of symmetry it is only necessary to calculate one case. After values of the TOFR parameter have been obtained, a cumulative distribution is formed and convolved to arrive at ε_{TOFR}.

The convolved cumulative error distribution, ε_T, is then plotted in the computer output as the predicted probability of interference P(I) versus dB error (ε). Since the input distributions are represented by worst-case interference conditions at the high end of the probability scale for the most positive cumulative error values, the convolved distribution then represents the worst-case value in a similar manner. The distribution type may be normal, or any other type, which may be determined by inspecting the plot. The probability of interference for a given pair may then be determined by:

$$\varepsilon = \overline{P}_{IN} - \overline{R}_S \tag{50}$$

where

ε = abscissa coordinate value of the plot ε_T, from which the desired ordinate P(I), (predicted probability of interference) can be determined.

As an example, see Figure 9. Using Equation 50, if $\overline{P}_{IN}$ is determined to be -95 dBm and $\overline{R}_S$ has a value of -100 dB, ε is equal to 5 dB. From inspection of the plot in Figure 9 one can determine the probability of interference for this transmitter/receiver pair; there is a 70% probability of interference. It can also be seen from the graph that, to decrease the probability of interference to, for example, 50%, the value of $\overline{P}_{IN}$ must be decreased 5 dB to -100 dB.

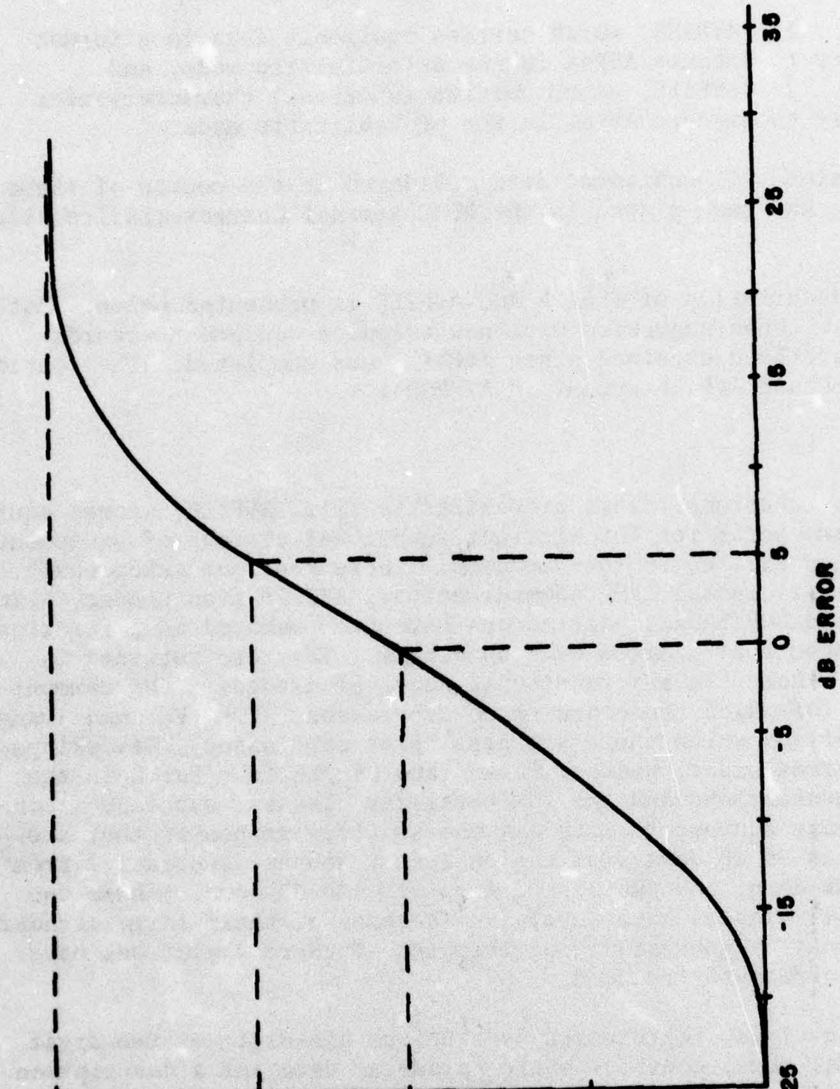


Figure 9. Example of a plot of the convolved cumulative error distribution (ϵ_T), represented as the predicted probability of interference versus dB error.

DATA BASES

There are two data base files associated with AVPAK 3:

1. AVBASE, which carries equipment data in a format necessary to execute AVPAK in the deterministic mode, and
2. AVFILE, which carries functional characteristics necessary to execute AVPAK in the probabilistic mode.

In addition, all equipment data collected in the course of these projects has been placed in the ECAC Nominal Characteristics File (NCF).

A description of AVBASE and AVFILE is presented below. Both files have been augmented with new avionics equipment records which have been obtained since AVPAK 2 was completed. The contents of AVBASE and AVFILE appear in APPENDIX D.

AVFILE

The functional class probabilistic file, AVFILE, stores equipment characteristics for distinct functional classes of equipment, as defined earlier in this section. There are four functional transmitter classes; VHF communications, ATCRBS transponder, Weather Radar, and DME/TACAN. Altimeters have been removed as a functional class because of limited data available. They are retained in AVBASE. There are six functional receiver classes: VHF communications (of which there are three subclasses), VOR (VHF omni-range)/Localizer (of which there are also three subclasses), Glideslope, ATCRBS transponder, Weather Radar, and DME/TACAN. For both the VHF communications and the VOR/Localizer classes, subclass 1 contains those equipments with maximum spurious responses that are as much as 89 dB down from the on-tune response, subclass 2 from 90-109 dB down, and subclass 3 from 110-140 dB down. These two functional classes have subclasses because of their large standard deviations; by subclassifying them the standard deviations have been significantly reduced.

Each class, represented by a unique one-digit or two-digit functional code, contains basic parameter data and a description of the sampled data used to derive the parameters. Numeric codes 1 through 49 inclusive are reserved for transmitters and codes 50 through 99 inclusive are reserved for receivers. There are no functional antenna classes.

AVBASE

Execution of AVPAK in the deterministic mode requires parameters not readily available from technical manuals. Specific

analyses of technical manuals was accomplished at ECAC in order to develop such characteristics as IF- and RF-slope fall offs, etc. AVBASE may be considered as a storage vehicle for these characteristics. It should be noted that these values have been specifically developed to drive the AVPAK model and are not for general use. Those values found in the ECAC Nominal Characteristics File are for general usage.

Each AVBASE record is represented by a unique identifier code (see TABLE 2). Numeric codes 5100 through 8999 inclusive are reserved for transmitters, codes 100 through 3999 inclusive are reserved for receivers.

TABLE 2

AVBASE EQUIPMENT IDENTIFICATION NUMBERS

Manufacturer	Receivers	Transmitters
ARC-CESSNA	100	5100
BENDIX	500	5500
COLLINS	900	5900
DYNAIR - RADAIR	1300	6300
EDO - AIRE	1700	6700
GENAVE	2100	7100
KING	2500	7500
NARCO	2900	7900
RCA	3300	8300
WILCOX	3700	8700
Function	**Receiver Sub-I.D.**	**Transmitter Sub-I.D.**
VHF Omni-range/localizer	00 - 49	
VHF Communications	50 - 99	50 - 99
Glide Slope	100 - 139	100 - 139
ATCRBS Transponder	140 - 179	140 - 179
Weather Radar	180 - 219	180 - 219
Distance Measuring Equipment	220 - 239	220 - 239
Altimeter	260 - 299	260 - 299

Note: An equipment I.D. is created by adding the manufacturer's I.D. to the functional Sub-I.D. For example, a Bendix communications receiver number would fall between 550 and 599 inclusive.

SECTION 4

PROGRAM UTILIZATION

GENERAL

This section discusses the control and data cards that are necessary to run AVPAK 3. APPENDIX E contains several sample runs for the various calculations and configurations that are handled by the program.

BASIC AVPAK 3 DECK

The standard card deck used in executing the AVPAK 3 model on ECAC's UNIVAC 1110 Computer is as follows:

```
@RUN
@QUAL HASELTINE
@MAP, IS, AVPAK3
IN ECAC*LIFIL/U.AVPAK3
LIB ECAC*LIFIL/U.
NOT ECAC*LIFIL/U.RANTEN
LIB ECAC*MODLIB/U.
LIB ECAC*LIB/U.
@SEC, U
@XQT AVPAK3
(Data Sets)
@EOF
@PMD,E
@FIN
```

DATA CARDS

The card formats for the data cards are listed in TABLES 3 through 12 and the coordinate system for determining main beam pointing angles in intersite analyses is illustrated in Figure 10. Details on these cards and also on program utilization can be found in Reference 12.

TABLE 3

GENERAL PARAMETER DATA CARD

Required	Column(s)	Format	Description	Units
Yes	1 - 3	INT[a]	Total number of transmitters (50 Maximum)	
Yes	4 - 6	INT[a]	Total number of receivers or power density points (50 maximum)	
Yes	7 - 10	INT[a]	Total number of antennas (100 maximum)	
Yes	12	INT[a]	Calculation desired: (0 or ₿ = interference to noise ratio, 1 = power density)	
Yes	14	INT[a]	Analysis desired: (0 or ₿ = cosite, 1 = intersite)	
Yes	16	INT[a]	INR answer type: (0 or ₿ = not applicable, 1 = deterministic, 2 = functional, 3 = probabilistic)	
Yes	18	INT[a]	Coordinate system to be used for inputs: [1 = rectangular (X, Y, Z), 2 = buttline, waterline fuselage station (B, W, F), 3 = cylindrical (ρ, θ, Z)]	
Yes	19 - 24	FP[b]	Maximum fuselage radius	in.
No	25 - 30	FP[b]	Bulkhead distance aft from nose	in.
No	31 - 36	FP[b]	Bulkhead height above fuselage centroid	
No	40 - 78	FLD[c]	Title of run	

[a]INT: integer value, must be right justified.

[b]FP: floating point value, must contain a decimal point.

[c]FLD: field data (character data).

TABLE 4

INTERSITE DATA CARD

Required	Column(s)	Format	Description	Units
No, unless site 1 to site 2 ground distance and site 1 to site 2 bearing not given	1 - 2	INT	Latitude of site 1	Degrees
	4 - 5	INT	Latitude of site 1	Minutes
	7 - 8	INT	Latitude of site 1	Seconds
	9	FLD	Lat. direction of site 1, N=North, S=South	
	11 - 13	INT	Longitude of site 1	Degrees
	15 - 16	INT	Longitude of site 1	Minutes
	18 - 19	INT	Longitude of site 1	Seconds
	20	FLD	Long. direction of site 1, E=East, W=West	
No, unless site 1 is an airplane	21 - 24	FP	Heading of site 1 with respect to airframe orgin	Degrees
Yes	25 - 33	FP	Altitude of site 1	Feet
No, unless site 1 to site 2 ground distance and site 1 to site 2 bearing not given	35 - 36	INT	Latitude of site 2	Degrees
	38 - 39	INT	Latitude of site 2	Minutes
	41 - 42	INT	Latitude of site 2	Seconds
	43	FLD	Lat. direction of site 2, N=North, S=South	
	45 - 47	INT	Longitude of site 2	Degrees
	49 - 50	INT	Longitude of site 2	Minutes
	52 - 53	INT	Longitude of site 2	Seconds
	54	FLD	Longitude direction of site 2, E=East, W=West	
No, unless site 2 is an airplane	55 - 58	FP	Heading of site 2 with respect to airframe orgin	Degrees
Yes	59 - 67	FP	Altitude of site 2	Feet
No, unless both site latitudes, longitudes are not given	68 - 73	FP	Ground distance from site 1 to site 2	Statute miles
	74 - 76	FP	True bearing from site 1 to site 2	Degrees
Yes	77	INT	Site 1 platform indicator: (0=fixed, 1=moving)	
Yes	79	INT	Site 2 platform indicator: (0=fixed, 1=moving)	

TABLE 5

WING OBSTRUCTION DATA CARD

Required	Column(s)	Format	Description	Units
Yes	1 - 4	FLD	The characters "WING"	
Yes	8 - 12	FP	BL-, X-, or ρ-dimension of forward starboard wing fuselage intersection point	inches
Yes	14 - 18	FP	WL-, Y-, or θ-dimension of forward starboard wing fuselage intersection point	inches/degree
Yes	20 - 24	FP	FS- or Z-dimension of forward starboard wing fuselage intersection point	inches
Yes	26 - 30	FP	BL-, X-, or ρ-dimension of aft starboard wing fuselage intersection point	inches
Yes	32 - 36	FP	WL-, Y-, or θ-dimension of aft starboard wing fuselage intersection point	inches/degree
Yes	38 - 42	FP	FS- or Z-dimension of aft starboard wing-fuselage intersection point	inches

TABLE 6

FUSELAGE OBSTRUCTION ONLY DATA CARD

Required	Column(s)	Format	Description	Units
Yes	1 - 4	FLD	The characters "NONE", (no wing or wing-pod obstruction)	--

TABLE 7

WING-POD (OR WEAPON) OBSTRUCTION DATA CARD

Required	Column(s)	Format	Description	Units
Yes	1 - 6	FLD	The characters "WEAPON"	
Yes	8	INT	Weapon number (1, 2, 3, ..., 10)	
Yes	10 - 15	FP	BL-, X-, ρ-dimension of weapon nose-centroid	inches
Yes	17 - 22	FP	WL-, Y-, or θ-dimension of weapon nose-centroid	inches/degree
Yes	24 - 29	FP	FS- or Z-dimension of weapon nose-centroid	inches
No	31 - 42	FLD	Weapon nomenclature	
Yes	43 - 47	FP	Weapon radius	inches

TABLE 8

ANTENNA OR POWER DENSITY POINT LOCATION DATA CARD

Required	Column(s)	Format	Description	Units
Yes	1 - 3	INT	Antenna number	
Yes	5	INT	Site number	
No	7 - 18	FLD	Nomenclature	
No, except for INR runs	20	INT	Type indication: (1=dipole, 2=loop, 3=blade, 4=horn, 5=circular aperture, 6=rectangular aperture)	
No, except for INR runs	22	INT	Location indicator: (1=nose, 2=tail, 3=wing, 4=fuselage, 5=weapon)	
No	24 - 26	FP	Gain	dBi
No	27	FLD	Polarization: V=vertical, H=horizontal	
No, except for INR runs with antenna types 4, 5, or 6	30 - 32	FP	X-dimension or diameter of aperture	inches
No, except for INR runs with antenna types 4 or 6	34 - 36	FP	Y-dimension of aperture	inches
No, except for INR runs with antenna types 4, 5, or 6	38 - 41	FP	Relative bearing or roll angle of main beam (MBϕ)	degree
No, except for intersite INR runs with antenna types 4, 5, or 6	43	FLD	Right/left indicator for MBϕ	
No, except for intersite INR runs with antenna types 4, 5, or 6	45 - 48	FP	Elevation or pitch angle of main beam (MBθ)	degree
No, except for intersite INR runs with antenna types 4, 5, or 6	50	FLD	Forward/aft indicator for main beam (MBθ)	
No, except for a cosite analysis	52 - 56	FP	BL-, X-, or ρ-coordinate of antenna or power density point	inches
No, except for a cosite analysis	58 - 62	FP	WL-, Y-, or θ-coordinate of antenna or power density point	inches/degree
No, except for a cosite analysis	64 - 68	FP	FS- or Z-coordinate of antenna or power density point	inches
No	71 - 74	INT	Key number for AVBASE data file	
No, unless located on a weapon	76	INT	Weapon coordinate system to use: 0=N/A, i.e. not on a weapon 1, 2, ..., 10 = number corresponding to a particular weapon	

TABLE 9

TRANSMITTER DATA CARDS

Required							
D1[a]	D2[b]	F[c]	P[d]	Column(s)	Format	Description	Units
Yes	Yes	Yes	Yes	1 - 3	INT	Number of antennas used by transmitter	
No	No	No	No	4 - 15	FLD	Nomenclature	
Yes	No	No	No	17 - 22	FP	Lower operating frequency	MHz
Yes	No	No	No	24 - 29	FP	Upper operating frequency	MHz
No	Yes	Yes	Yes	30 - 33	INT	Functional file (AVFILE) or Data Base file (AVBASE) code number	
No	No	No	No	35 - 38	FP	First emission bandwidth	MHz
No	No	No	No	40 - 43	FP	Second emission bandwidth	MHz
No	No	No	No	45 - 48	FP	First emission slope falloff	dB/decade
No	No	No	No	50 - 53	FP	Second emission slope falloff	dB/decade
Yes	No	No	No	55 - 57	FP	Power	dBm
Yes	No	No	No	58 - 62	FP	Emission designator - bandwidth	MHz
Yes	No	No	No	64 - 65	FLD	Emission designator - modulation type	
No	No	No	No	67	FLD	Pulse compression indicator "b̸"=not pulsed, "c"= pulsed	
Yes	No	No	No	68 - 71	FP	Pulse width	μs
Yes	No	No	No	72 - 75	FP	Average pulse rise and fall time	μs
No[e]	No	No	No	76 - 79	FP	Pulse repetition frequency	kHz
No	Yes	Yes	Yes	80	INT	Presence of second transmitter data card indicator, b̸=no second card present, all data on first card, 1=read second card for additional transmitter data	
				second card			
No	No	No	No	1 - 6	FP	Lower transmitter filter limit	MHz
No	No	No	No	8 - 13	FP	Upper transmitter filter limit	MHz
Yes	No	No	No	15	INT	Number of transmitter harmonics to consider in EMC analysis (1, 2, 3, ..., 9)	
No	No	No	No	17 - 20	FP	Suppression level of second harmonic	dB
No	No	No	No	22 - 25	FP	Suppression level of third harmonic	dB
No	No	No	No	27 - 30	FP	Suppression level of fourth harmonic	dB
No	No	No	No	32 - 35	FP	Suppression level of fifth harmonic	dB
No	No	No	No	37 - 40	FP	Suppression level of sixth harmonic	dB
No	No	No	No	42 - 45	FP	Suppression level of seventh harmonic	dB
No	No	No	No	47 - 50	FP	Suppression level of eighth harmonic	dB
No	No	No	No	52 - 55	FP	Suppression level of ninth harmonic	dB

[a]D1: deterministic type run, not using AVBASE.

[b]D2: deterministic type run, using AVBASE.

[c]F: functional type run.

[d]P: probabilistic type run.

TABLE 10

COMMENTS ON TRANSMITTER DATA CARDS

Field or Parameter	Acceptable Range or Value	Recovery Value
Nomenclature	N/A	A 12 character random dummy name
Pulse compression indicator	Must be blank or "C"	Set to "C" if modulation type is P9
Pulse rise/fall time	Must be less than pulsewidth	1/10 of pulsewidth, PW
First emission bandwidth	Must be less than second emission bandwidth; product of first emission bandwidth and pulsewidth must be at 1.0 for a chirped equipment	For modulation type A- or F- set to emission designator bandwidth EDBW. For modulation type P9, set to: $(EDBW)\left(1-\sqrt{\frac{2}{(EDBW)\ (PW)}}\right)$ For modulation type PO, set to: $\frac{1.28}{(2)\ (PW)}$
Second emission bandwidth	Must be greater than first emission bandwidth	For modulation type A- or F- set to EDBW times 10. For modulation type P9, set to: $(EDBW)\left(1+\sqrt{\frac{2}{(EDBW)\ (PW)}}\right)$ For modulation type PO, set to: $\frac{.64}{(\text{pulse rise/fall time})}$
First emission slope falloff	$\geq$20 dB/decade	For modulation type A- or F- set to 80 dB/decade. For modulation type PO set to 20 dB/decade. For modulation type P9 an approximation is made using PW, pulse rise/fall time, and first and second emission bandwidth.
Second emission slope fall-off	$\geq$20 dB/decade	For modulation types A- or F- set to 20 dB/decade. For modulation types PO or P9 set to 40 dB/decade.
Number of harmonics to be examined	$\geq$1 and $\leq$9	Set to 1 if blank
Harmonic suppression levels	N/A	Set to 60 dB if blank
Operating frequency	Upper frequency must be greater than or equal to lower frequency, average operating frequency must be at least 30 MHz	N/A
Filter frequency limit	Upper frequency must be greater than or equal to lower frequency	N/A
Pulsewidth	Must be greater than pulse rise/fall time; product of first emission bandwidth and pulsewidth must be at least 1 for a chirped equipment.	N/A

TABLE 11

RECEIVER OR POWER DENSITY POINT DATA CARD

Required							
D1[a]	D2[b]	F[c]	P[d]	Column(s)	Format	Description	Units
Yes	Yes	Yes	Yes	1 - 3	INT	Antenna or power density point number	
No	No	No	No	5 - 16	FLD	Nomenclature	
No	No	No	No	17	INT	Subclass indicator	
No[e]	No	No	No	18 - 23	FP	Lower operating frequency	MHz
No[e]	No	No	No	24- 29	FP	Upper operating frequency	MHz
No	Yes	Yes	Yes	30 - 33	INT	Functional file (AVFILE) or Data Base file	
No[e]	No	No	No	34 - 37	FP	IF bandwidth	MHz
No[e]	No	No	No	38 - 42	FP	Intermediate frequency	MHz
No[e]	No	No	No	44 - 47	FP	IF selectivity slope falloff	dB/decade
No	No	No	No	49 - 52	FP	RF selectivity slope falloff	dB/decade
No	No	No	No	53 - 56	FP	Image rejection	dB
No	No	No	No	57 - 60	FP	Spurious rejection	dB
No	No	No	No	61 - 65	FP	Lower spurious frequency limit	MHz
No	No	No	No	66 - 71	FP	Upper spurious frequency limit	MHz
No	No	No	No	72	FLD	Local oscillator position: "A" = above, "B" = below, "C" or blank = unknown	
No[e]	No	No	No	73 - 77	FP	Sensitivity	dBm
No	No	No	No	78 - 80	FP	S/I threshold level	dB

[a]D1: deterministic type run, not using AVBASE.

[b]D2: deterministic type run, using AVBASE.

[c]F: functional type run.

[d]P: probabilistic type run.

[e]No: No, except for INR run.

TABLE 12

COMMENTS ON RECEIVER OR POWER DENSITY POINT DATA CARD

Field or Parameter	Acceptable Range or Value	Recovery Value
RF selectivity slope falloff	≤200 dB/decade; >20 dB/decade	Set to 20 dB/decade; Set to 200 dB/decade if input as a larger number
Nomenclature	N/A	A 12 character random dummy name
IF selectivity slope falloff	>20 dB/decade	N/A
Image rejection	N/A	Set to 60 dB, if blank
Spurious rejection	N/A	Set to 60 dB, if blank
Lower spurious rejection frequency limit	Must be less than both lower operating frequency and upper spurious frequency limit	Set to [lower operating frequency - (2) (IF)], if blank
Upper spurious rejection frequency limit	Must be greater than both upper operating frequency and lower spurious frequency limit	Set to [upper operating frequency + (2) (IF)], if blank
Local oscillator position	N/A	Set to "C", if blank
Sensitivity	Must be negative	N/A
Signal-to-interference threshold level	N/A	Set to 20 dB, if blank
Lower operating frequency	Must be less than or equal to upper operating frequency	N/A
Upper operating frequency	Must be greater than or equal to lower operating frequency	N/A

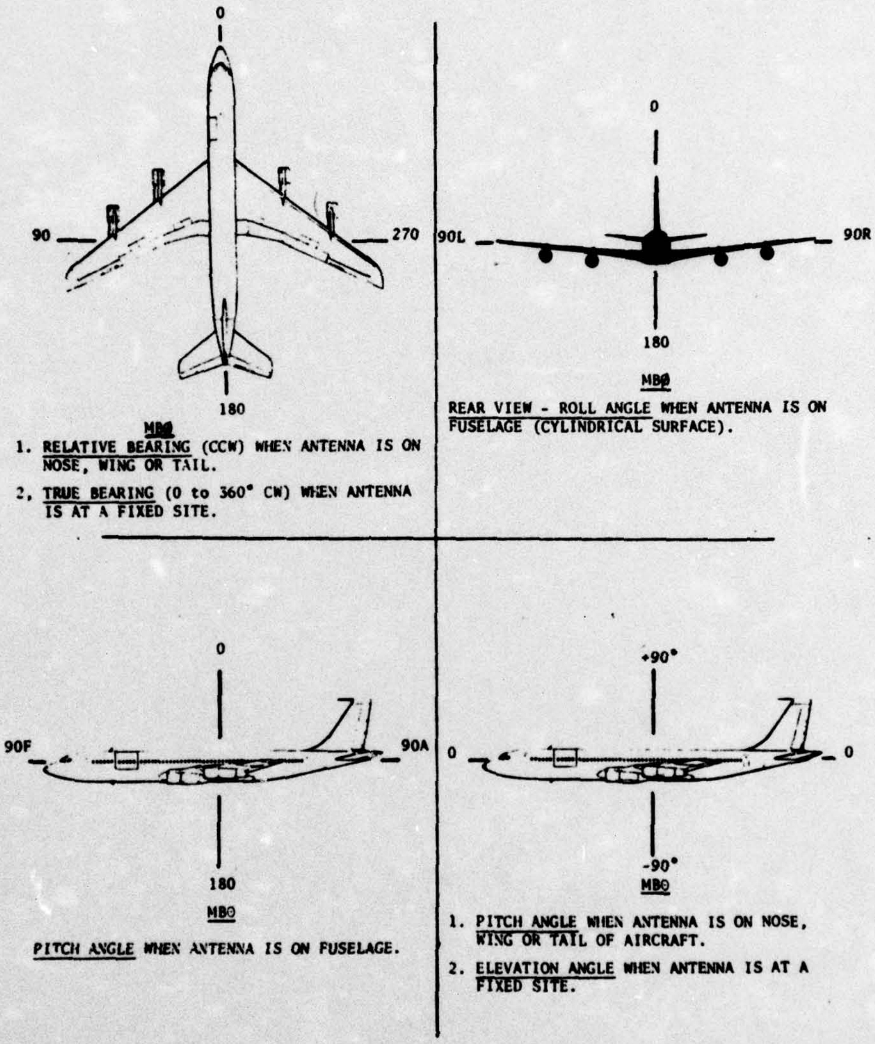


Figure 10. Aircraft coordinate system used for determining the main beam pointing angles (MBØ & MBΘ) of directional antenna in intersite analyses.

SECTION 5

SUMMARY

GENERAL

AVPAK is intended as a tool for identifying antenna-coupled interference problems on board aircraft. It will compute interference levels in avionics receivers from transmitters located on the same aircraft or at points remote from the aircraft. Further, it will compute power densities at any designated point from a transmitter or a number of transmitters.

AVPAK does not consider near-field antenna anomalies, nor does the model consider high-power nonlinear effects.

MODEL CAPABILITIES

The composite capabilities of the AVPAK 3 model are listed and discussed below, including responses to the most recent objectives set forth in Inter-Agency Agreement FA 70 WAI-175, Task Assignment No. 26.

1. *Calculation of the interference effects between both cosite and intersite transmitters and receivers operating on an aircraft.* This is done by determining the expected level of interference relative to the degradation threshold of each receiver. If this expected level equals or exceeds the threshold value, degradation is expected to occur. This calculation will take into account the following factors: antenna paths including those that encounter bulkheads, airfoils, and wing weapon pods, and also between antennas which are raised from the fuselage skin. As an additional user convenience, a preprocessor will insert certain nominal predetermined values if certain transmitter or receiver characteristic values are unknown.

2. *Two options in the type of interference calculation desired.* One is strictly a deterministic-type calculation between a given transmitter and receiver. The other is a probabilistic-type calculation using one of the two AVPAK data bases. This calculation yields a graph from which the user may determine the probability of interference between a transmitter-receiver pair and the alterations to the transmitted power which must be made in order to reduce the probability of interference.

3. *The development of two data bases associated with the AVPAK model, viz. AVBASE and AVFILE.*

a. AVBASE contains nominal characteristics of selected types of avionics transmitters and receivers. These

characteristics may be used in running the AVPAK model for a deterministic type run. This file has been updated to include newly manufactured equipment and currently contains 208 transmitters and 392 receivers. The equipment information in AVBASE is also contained in the ECAC Nominal Characteristics File (NCF). A listing of the ECAC NCF can be provided, if desired.

b. AVFILE is a functional file used for probabilistic processing. In AVFILE, avionic transmitters and receivers are grouped according to function. The group is represented by a single symbolic piece of equipment. Its characteristics are then determined from the median values of the equipment comprising the group. In order to have the functional file as statistically representative as possible of the equipment in each particular group, work has been done to redefine certain parameters which are used to represent the groups. This has resulted in two receiver groups being subclassified according to their spurious-response floor levels.

4. *A TSO/ARINC characteristic indicator for equipment located in AVBASE.* In investigating methods to make the AVFILE parameters more concise, avionic regulatory standards were investigated with the hope that grouping equipment by certain standards would yield more representative groupings. This did not prove advantageous. As a special option, the user may inspect a listing of AVBASE to determine what equipment has associated with it a TSO (Technical Standard Order) or an ARINC (Aeronautical Radio, Inc) characteristic.

5. *Calculation of power density on or near the airframe from antennas located on the airframe as well as from transmitters located on neighboring aircraft.* Output values are calculated in both dBm/m^2 and $volts/m^2$ and, if appropriate, the model will also calculate a cumulative value of the effects of more than one transmitter.

6. *The choice of three coordinate systems for user input; (X,Y,Z), (ρ,θ,Z), (B,W,F).* The model converts the latter two to cartesian coordinates.

7. *Validation of the coupling model.* A total of 996 coupling measurements were used to validate the model, 616 in the UHF portion of the spectrum and 380 in the SHF portion. For the UHF portion, a comparison of measured and AVPAK-calculated data yielded a mean error of -0.63 dB with a standard deviation of 5.25 dB. For the SHF portion, the mean error was +0.93 dB and the standard deviation was 5.7 dB. For the combined UHF and SHF data, the mean error was -0.019 dB with a standard deviation of 5.52 dB.

APPENDIX A

GEOMETRICAL THEORY OF DIFFRACTION

J. B. Keller in the early 1950's developed the "geometrical theory of diffraction" ("GTD") to account for the optical phenomenon of diffraction.[16] In addition to the usual rays of geometrical optics, GTD introduces new rays which can travel along curved lines and which can account for reflection from edges, corners, etc. These new rays obey several laws of diffraction which are analogous to the laws of reflection and refraction. All the fundamental principles of ordinary geometrical optics can be extended to geometrical diffraction. The only difficulty occurs in obtaining the initial value of the field at the point of diffraction. For ordinary rays, the field of a ray emerging from a source is specified at the source but for a reflected or transmitted ray, the initial value is obtained by multiplying the field of the incident ray by a reflection or transmission coefficient. For diffracted waves the initial values of the field are obtained by multiplying the field of the incident rays by a diffraction coefficient. There are different diffraction coefficients for edges, vertices, curved surfaces, etc. These diffraction coefficients are determined by the direction of incidence and diffraction, the wavelength, and the geometrical and physical properties of the medium at the point of diffraction (see Reference 4).

In an ECAC analysis the wing was modeled as a wedge. Figure A-1 shows the dimensions, angles and coordinate systems for two antennas on opposite sides of a wedge of angle α. In Sach's development of the diffraction by a single wedge (see Reference 4), the shadowing attenuation is determined by the following equation.

$$A_s = \frac{\sin^2 \pi/n}{4\pi^2 n^2} \quad \frac{\lambda \left[\left(\ell_1 + \ell_2\right)^2 + d^2\right]^{\frac{1}{2}} D_\theta^{\;2}}{\ell_1 \ell_2} \qquad \text{(A-1)}$$

where

A_s = shadowing attenuation of a single wedge in dB

n = variable determined from the wedge angle, α, such that $n = \frac{2\pi - \alpha}{\pi}$

[16]Keller, J. B., *The Geometrical Theory of Diffraction*, Symposium on Microwave Optics, McGill University, Montreal, Canada, June, 1953.

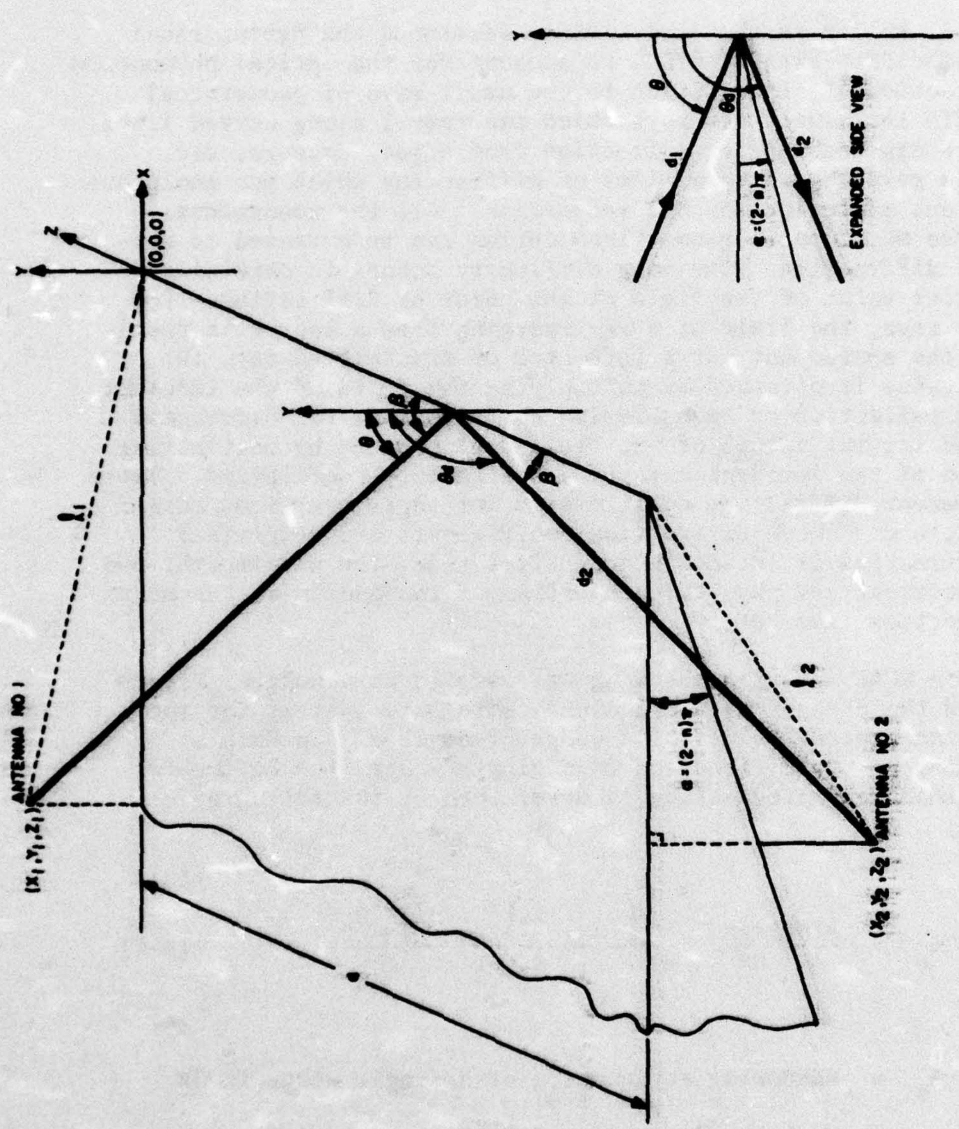


Figure A-1. Coordinate system used in analysis of a wedge using the "GTD".

λ = transmitted wavelength

ℓ_1 = minimum distance between antenna #1 and apex of wedge

ℓ_2 = minimum distance between antenna #2 and apex of wedge

d = distance between antenna #1 and antenna #2 along z axis, i.e., $z_2 - z_1$

D_θ = diffraction coefficient

and

$$D_\theta = \left[\left\{\cos\frac{\pi}{n} - \cos\left(\frac{\theta d - \theta}{n}\right)\right\}^{-1} \pm\left\{\cos\frac{\pi}{n} - \cos\left(\frac{\theta d + \theta + \pi}{n}\right)\right\}^{-1}\right] \qquad \text{(A-1a)}$$

θ = angle beyween y axis and incident ray

θd = angle between y axis and diffracted ray as shown in Figure A-1.

The negative sign is associated with soft screen boundary conditions, i.e., field component tangent with respect to the diffracting surface and the positive sign is associated with hard screen boundary conditions i.e., the field is normal with respect to diffracting surfaces.

For reasons explained in Section 2, DEVELOPMENT OF AN AIRFOIL OBSTRUCTION LOSS, this technique did not meet ECAC's objective and an alternative method was sought.

APPENDIX B

DESCRIPTION OF PARAMETERS USED TO CREATE THE FUNCTIONAL/PROBABILISTIC FILE

AVPAK COUPLING LOSS ERROR STATISTICS

Six sets of measurements have been examined to determine the error to be expected in the predicted coupling loss determined with the automated AVPAK coupling-loss routine. Five of the data sets include 616 measurements made at operating frequencies in the UHF portion of the spectrum.[17,18,19,20,21]

Two of these UHF sets constitute a new validation of the model; the remaining UHF and SHF sets were previously used in the validation of the AVPAK 2 model.

The sixth set of data[22] includes 380 measurements made at SHF operating frequencies between 2.0 and 9.6 GHz. These measurements were part of a classified program and are not contained in a published report.

UHF Measurements Results

An examination of this data indicates that the mean error ($\bar{\chi}$) is -.63 dB and the standard deviation of the error is 5.25 dB. As used herein, a negative error indicates that the measured coupling loss was lower than the AVPAK predicted coupling loss and a positive error indicates that the measured loss was higher then the predicted value.

---

[17]Electronic Communications, Inc., *Electromagnetic Compatibility Report for KC-135B Aircraft,* January 1965.

[18]The Boeing Corporation, *Category II Flight Test Report for KC-135B (PACCS) Electronic System,* Test No. T6-3181, 1965.

[19]Martin, H., *Measured Adjacent Signal Interference of Collocated AN/ARC-51 Transceivers (U),* ESD-TR-67-003, January 1968, CONFIDENTIAL.

[20]The Boeing Corporation, *EC-135C AFSAT EMC Baseline Measurements and Analysis,* Test No. T3-1702, July 1974.

[21]E-System Inc., Garland Division, Model No. E-4A, Report No. G8494.12.26, 1973.

[22]Zimballatti, A., Grumman Aircraft Corporation, Personal Contact, June 1972.

The error distribution appears to be normal with a median error of 0 dB and a standard error of 6.0 dB, based on a χ^2 (chi-square) test with 6 degrees of freedom at a .05 significance level. The range of errors observed is shown in Figure B-1.

SHF Measurement Results

The SHF data fell into two categories. The first category included 292 measurements with antennas situated such that the measurements provided comparisons of observations versus predictions from the AVPAK knife-edge coupling subroutine. The remaining 88 measurements were made between antenna pairs with both antennas mounted aft of the nose bulkhead. The second category of data enabled an examination of the raised antenna versus surface-mounted antenna subroutine and the routine which calculates coupling loss along a curved surface.

The range of errors observed for the first set of SHF data is shown in Figure B-2.

The results of the first category of SHF measurements indicate that the mean error ($\overline{\chi}$) is +1.05 dB; the standard deviation of the error (σ) is 6.0 dB. The error distribution was tested using a χ^2 (chi-square) test at a .05 significance level using 6 degrees of freedom. The results indicate that these errors are normally distributed with a median error of 0 dB and a standard deviation of 6.0 dB.

The mean error ($\overline{\chi}$) of the second set of SHF measurements was found to be +.07 dB and the standard deviation, 4.9 dB.

When both SHF categories were considered as one group, it was found that the mean error, ($\overline{\chi}$) was +0.93 dB and the standard error (σ), 5.7 dB. The distribution of the combined SHF errors appears to be normal with a median error of 0 dB and a standard error of 6.0 dB, based on a χ^2 (chi-square) test at .05 significance level and 6 degrees of freedom. The range of errors for the combined 380 SHF measurements may be observed in Figure B-3.

SUMMARY OF COMBINED RESULTS

A total of 996 measurement points were evaluated to determine the error to be expected in the AVPAK coupling loss predictions. The range of observed errors of all the measurements is presented in Figure B-4. The distribution of the expected errors appears to

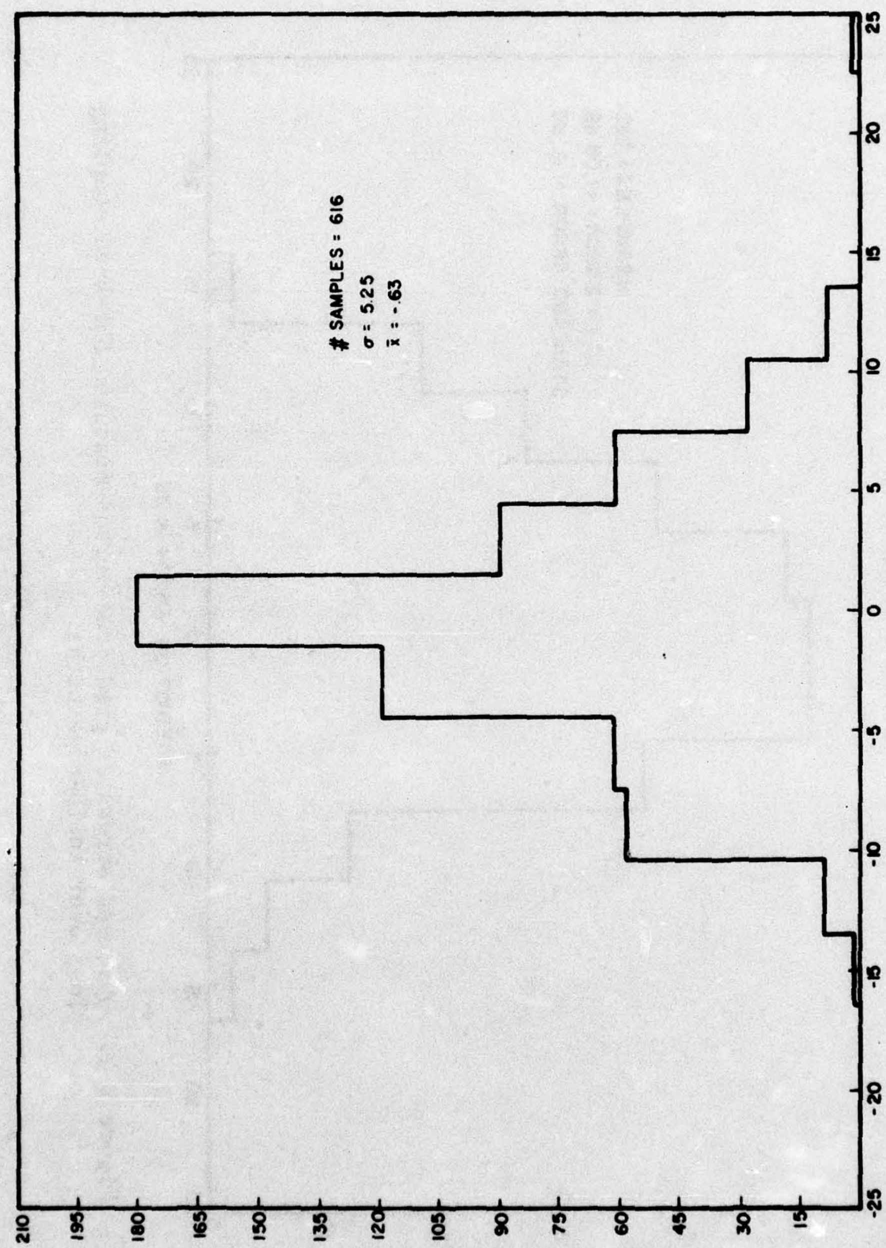


Figure B-1. Observed errors in UHF coupling loss prediction.

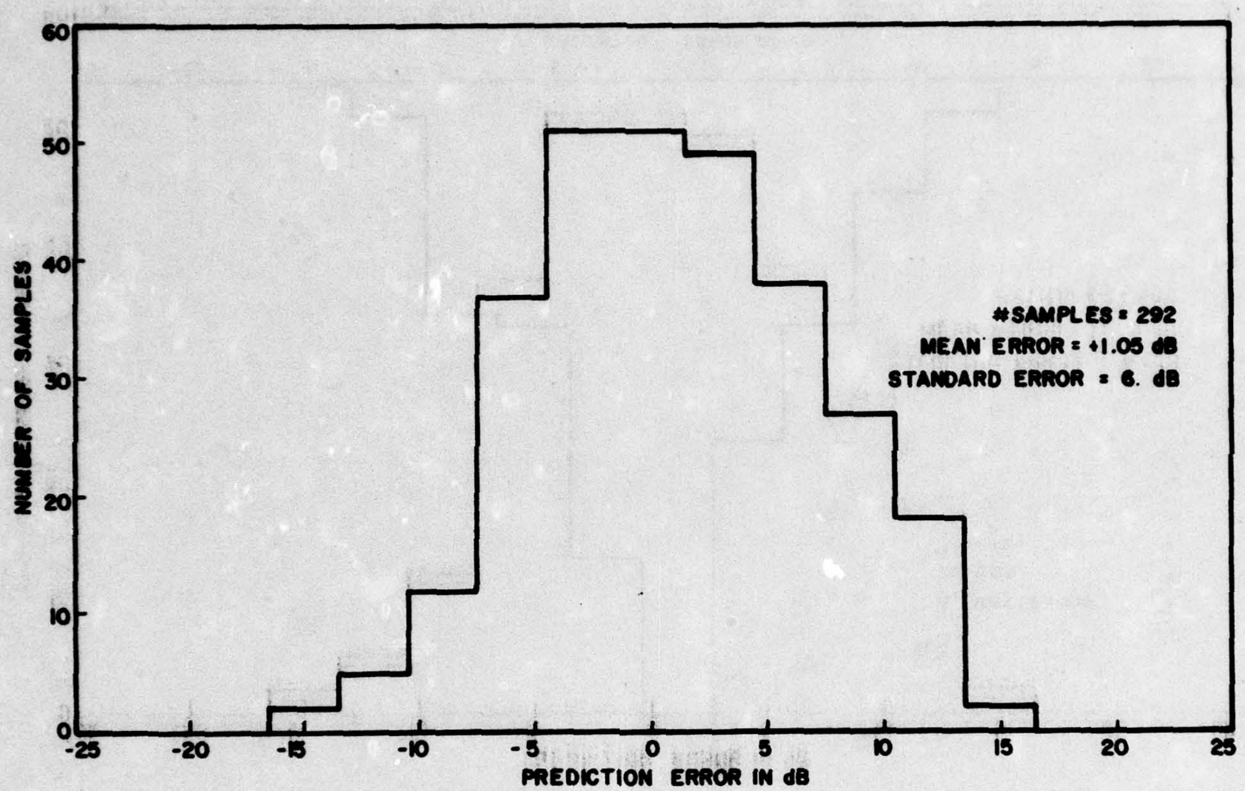


Figure B-2. Observed errors of predicted-versus-measured SHF-band coupling loss over knife-edge paths.

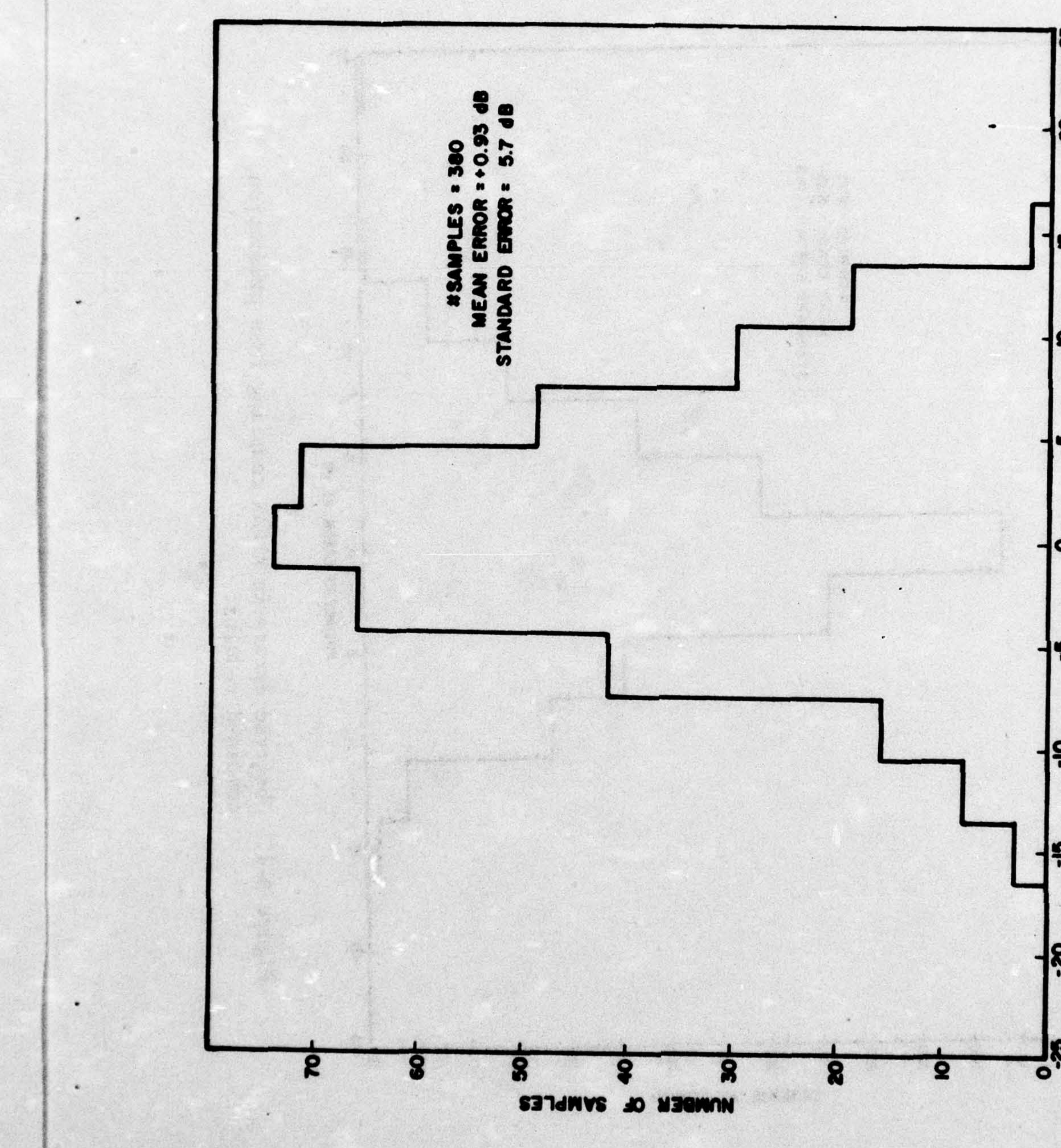


Figure B-3. Observed errors of predicted-versus-measured coupling loss in the SHF band - all paths.

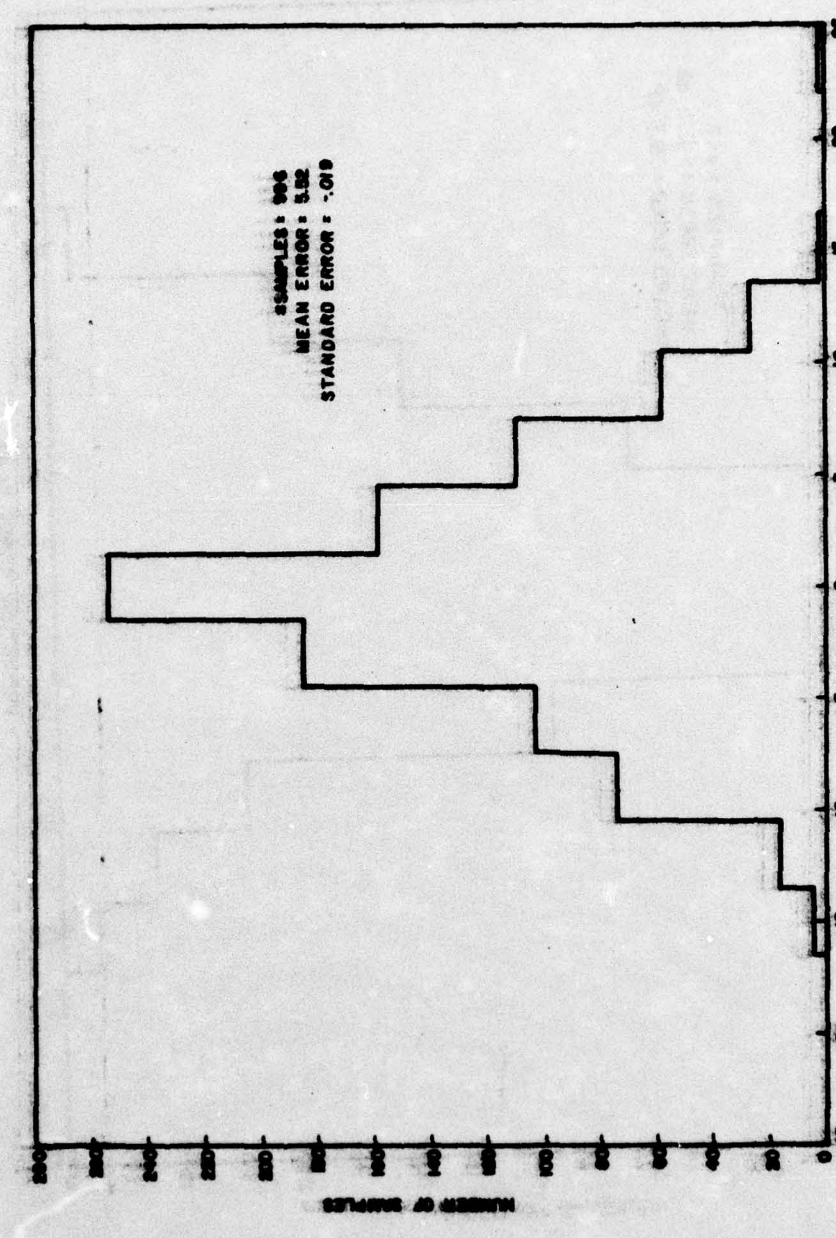
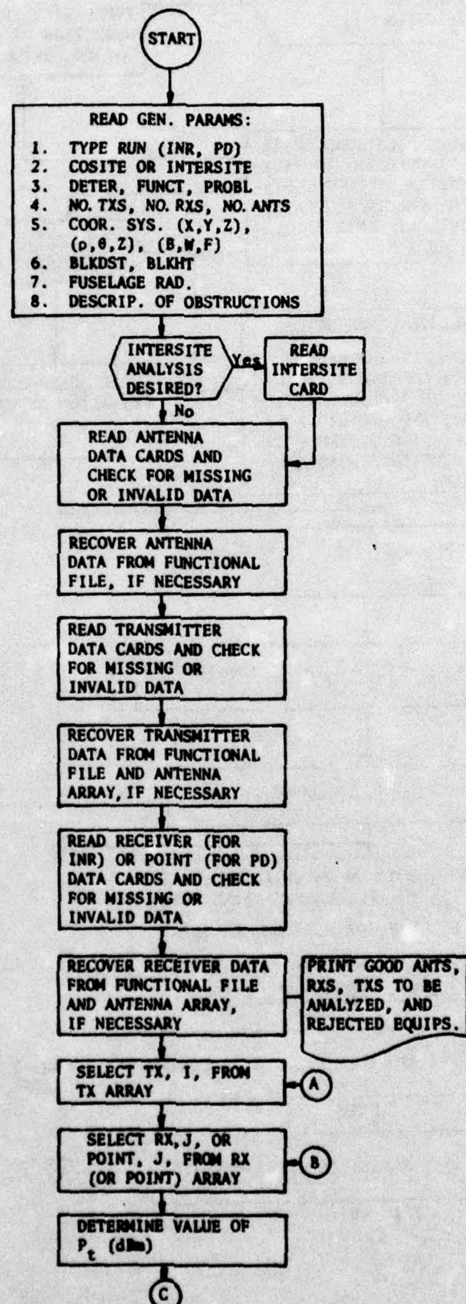


Figure B-4. Observed errors in AVPAK coupling loss prediction, combined results.

be normal with a mean error, $(\bar{X})$, of -.019 dB and a standard deviation of 5.52 dB. The expected errors in the automated AVPAK coupling loss routine have been represented as a median error of 0 dB and a standard error of 6.0 dB based on a χ^2 (chi-square) test with 6 degrees of freedom at a .05 significance level.

APPENDIX C

GENERAL FLOW CHART FOR AVPAK 3
(Page 1 of 3)



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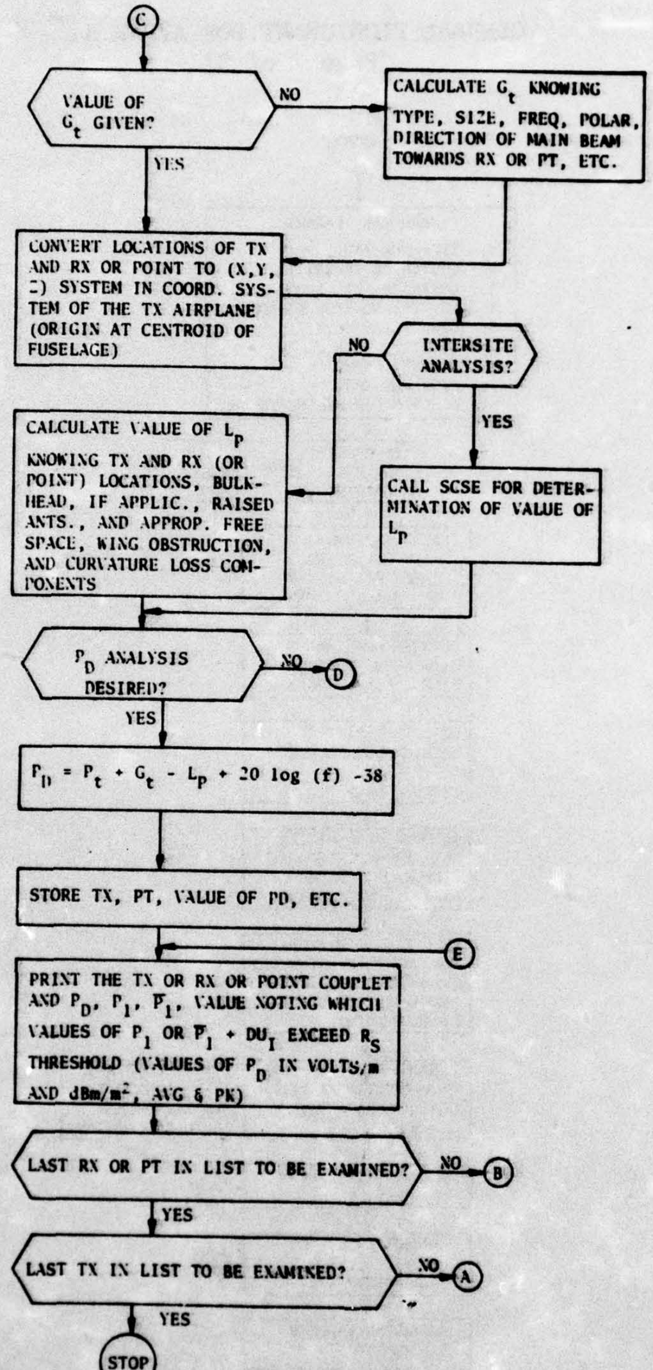
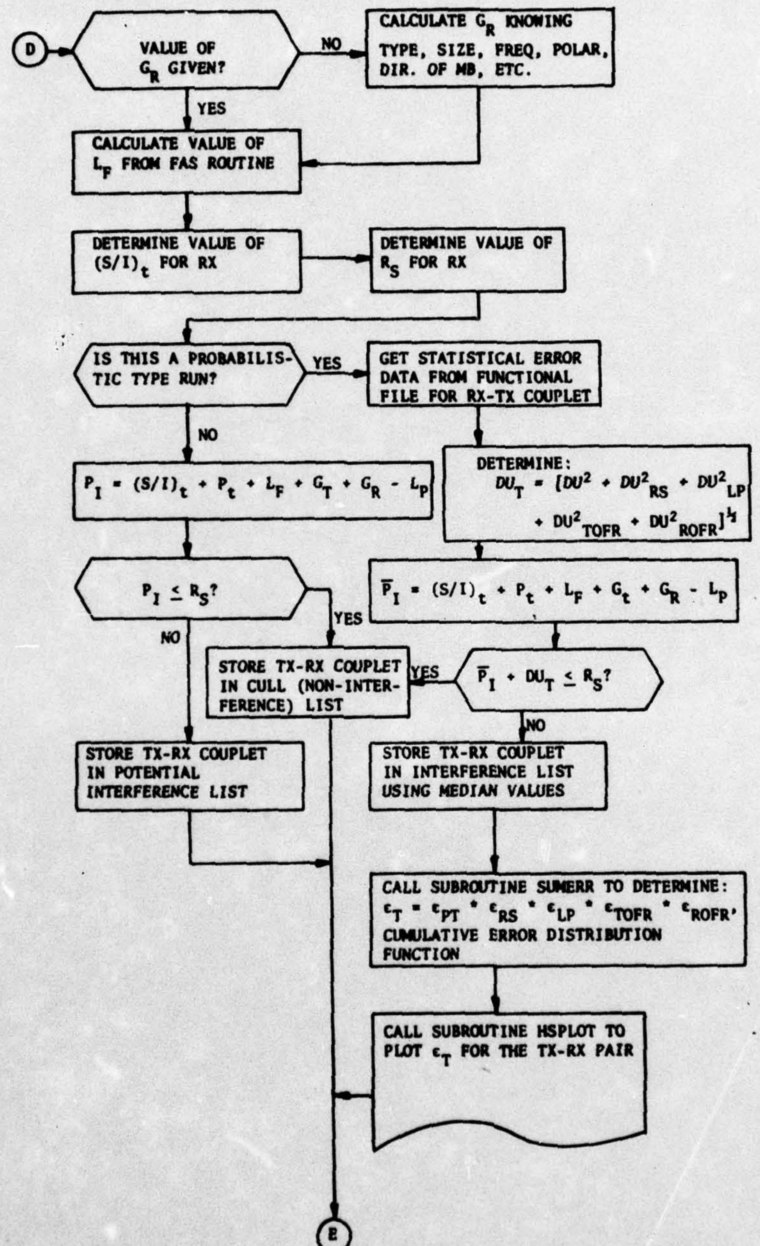

C
VALUE OF G_t GIVEN?
NO
CALCULATE G_t KNOWING TYPE, SIZE, FREQ, POLAR, DIRECTION OF MAIN BEAM TOWARDS RX OR PT, ETC.
YES
CONVERT LOCATIONS OF TX AND RX OR POINT TO (X,Y,Z) SYSTEM IN COORD. SYSTEM OF THE TX AIRPLANE (ORIGIN AT CENTROID OF FUSELAGE)
INTERSITE ANALYSIS?
NO
YES
CALCULATE VALUE OF L_p KNOWING TX AND RX (OR POINT) LOCATIONS, BULKHEAD, IF APPLIC., RAISED ANTS., AND APPROP. FREE SPACE, WING OBSTRUCTION, AND CURVATURE LOSS COMPONENTS
CALL SCSE FOR DETERMINATION OF VALUE OF L_p
P_D ANALYSIS DESIRED?
NO
D
YES
$P_D = P_t + G_t - L_p + 20 \log (f) - 38$
STORE TX, PT, VALUE OF PD, ETC.
E
PRINT THE TX OR RX OR POINT COUPLET AND P_D, P_1, $\overline{P}_1$, VALUE NOTING WHICH VALUES OF P_1 OR $\overline{P}_1$ + DU_I EXCEED R_S THRESHOLD (VALUES OF P_D IN VOLTS/m AND dBm/m^2, AVG & PK)
LAST RX OR PT IN LIST TO BE EXAMINED?
NO
B
YES
LAST TX IN LIST TO BE EXAMINED?
NO
A
YES
STOP

(Page 3 of 3)


D
VALUE OF G_R GIVEN?
NO
CALCULATE G_R KNOWING TYPE, SIZE, FREQ, POLAR, DIR. OF MB, ETC.
YES
CALCULATE VALUE OF L_P FROM FAS ROUTINE
DETERMINE VALUE OF $(S/I)_t$ FOR RX
DETERMINE VALUE OF R_S FOR RX
IS THIS A PROBABILISTIC TYPE RUN?
YES
GET STATISTICAL ERROR DATA FROM FUNCTIONAL FILE FOR RX-TX COUPLET
NO
$P_I = (S/I)_t + P_t + L_F + G_T + G_R - L_P$
DETERMINE: $DU_T = [DU^2 + DU^2_{RS} + DU^2_{LP} + DU^2_{TOFR} + DU^2_{ROFR}]^{1/2}$
$P_I \leq R_S$?
$\overline{P}_I = (S/I)_t + P_t + L_F + G_t + G_R - L_P$
YES
NO
STORE TX-RX COUPLET IN CULL (NON-INTERFERENCE) LIST
YES
$\overline{P}_I + DU_T \leq R_S$?
NO
STORE TX-RX COUPLET IN POTENTIAL INTERFERENCE LIST
STORE TX-RX COUPLET IN INTERFERENCE LIST USING MEDIAN VALUES
CALL SUBROUTINE SUMERR TO DETERMINE: $\epsilon_T = \epsilon_{PT} * \epsilon_{RS} * \epsilon_{LP} * \epsilon_{TOFR} * \epsilon_{ROFR}$, CUMULATIVE ERROR DISTRIBUTION FUNCTION
CALL SUBROUTINE HSPLOT TO PLOT ϵ_T FOR THE TX-RX PAIR
E

APPENDIX D

LISTING OF THE CONTENTS OF AVBASE AND AVFILE

The information in the AVBASE and AVFILE files is intended to be used as input data to the AVPAK 3 model. It may not be directly comparable to published specifications. Many parameters were synthesized using equipment schematics, for reasons discussed on pages 10 and 11. Abbreviations used in the AVBASE file, listed first, are defined in TABLE D-1.

In the computer printout that follows TABLE D-1, entries of ".0," ".00" and ".000" should be read as blanks.

TABLE D-1

AVBASE ABBREVIATIONS
(Page 1 of 4)

BW1:	The emission envelope bandwidth of the first breakpoints. This is the nominal 3 dB bandwidth in MHz (pp. 35-36).
BW2:	The emission envelope bandwidth of the second breakpoints. This is the bandwidth at which the envelope shows a second fall-off characteristic and is in MHz.
EBW:	Emission designator bandwidth. It is the bandwidth containing 99% of the mean radiated power. Its units are MHz.
FLD:	Field format.
FP:	Floating point format.
HI FLT:	Upper filter frequency in MHz. The lower and upper filter limits are used to truncate the spectral energy of the transmitted emissions outside the two frequencies given. The primary application for these data is to describe waveguide cut-off phenomena.
HI FRQ:	Upper operating frequency of the equipment. Its units are MHz.
HI SPR FRQ:	Upper spurious response limit. Similar to LO SPR FRQ but related to upper side of the RF selectivity curve. Its units are in MHz.
IF:	Intermediate frequency. It is the first intermediate frequency if there is more than one. Its units are MHz.
IF BW:	Intermediate frequency bandwidth. This is the final IF 3 dB bandwidth. Its units are MHz.
IF SF:	Intermediate frequency (final IF) selectivity slope. Its units are dB/decade. (See IF Skirt Slope, p. 29.)
IM REJ:	Image rejection. Its units are dB (p. 33).
INT:	Integer format.

TABLE D-1

(Page 2 of 4)

KEY NO:	The key number of a unique equipment I.D. assigned in alpha-numeric order according to manufacturer and equipment function (pp. 54-55).
LO FLT:	Lower filter frequency in MHz (see HI FLT, on previous page).
LO FRQ:	Lower operating frequency of the equipment. Its units are MHz.
LO POS:	Local oscillator position. A = above, B = below, relative to the carrier frequency. If an input is not given it is assigned a "C" and treated as being both above and below the carrier.
LO SPR FRQ:	Lower spurious response limit. It is a discrete frequency defined by the intersection of the spurious floor with the lower frequency side of the RF selectivity curve. Its units are in MHz (P. 35).
MOD TYP:	FCC emission modulation type. Emissions are classified and symbolized according to the following characteristics:

Types of modulation of main carrier:	Symbol
a) Amplitude	A
b) Frequency (or Phase)	F
c) Pulse	P

Types of transmissions:	
a) Absense of any modulation intended to carry information.	0
b) Telegraphy without the use of a modulating audio frequency.	1
c) Telegraphy by the on-off keying of a modulating audio frequency or audio frequencies, or by the on-off keying of the modulated emission. (Special case: an unkeyed modulated emission.)	2
d) Telephony (including sound broadcasting).	3
e) Facsimile (with modulation of main carrier either directly or by a frequency modulated sub-carrier).	4

TABLE D-1

(Page 3 of 4)

		Symbol
f)	Television (vision only)	5
g)	Four-frequency diplex telegraphy	6
h)	Multichannel voice-frequency telegraphy	7
i)	Cases not covered by the above	9

Supplementary characteristics:

		Symbol
a)	Double sideband	(none)
b)	Single sideband:	
	reduced carrier	A
	full carrier	H
	suppressed carrier	J
c)	Two independent sidebands	B
d)	Vestigial sideband	C
e)	Pulse:	
	amplitude modulated	D
	width (or duration) modulated	E
	phase (or position) modulated	F
	code modulated	G

NOMENCLATURE:
1) First part of column: Manufactures unique name of equipment, further identified by "KEY NO." to manufacturer (see p. 55).
2) Second part of column: Type of equipment (i.e., C = VHF Comm.; VL = VOR, Localizers; G = Glideslope; ATC = Air Traffic Control Transponders; WR = Weather Radar; DME = Distance Measuring Equipment; ALT = Altimeter).

PCI: Pulse compression indicator. This requires a "C" for chirp modulation only, otherwise this field is blank.

PRF: Pulse repetition frequency. Its units are Hz.

PW: Pulse width. It is the value between half amplitude points. For chirped modulation it is the stretched width. Its units are μs. (See p. 38 for explanation of stretched width.)

TABLE D-1

(Page 4 of 4)

PWR:	The transmitter power. It is the average power output for communication transmitters and the peak power output for pulsed transmitters. Its units are dBm.
R/F:	The average pulse rise and fall time (δ). It is determined from: $\delta = \frac{2}{1/\delta_r + 1/\delta_f}$ where δ_r = the time for the pulse to rise from its 10% amplitude to its 90% value and δ_f = the time to fall from 90% to 10%. Its units are μs.
RF SF:	RF selectivity slope. Its units are dB/decade (p. 29).
SENS:	Receiver sensitivity. It must be preceded by a negative sign. Its units are dBm.
SF1:	The first slope fall-off of the emission envelope. It is the slope adjacent to the 3 dB bandwidth. Its units are dB/decade (see M_1, p. 37).
SF2:	The second slope fall-off of the emission envelope. It is the slope at frequencies greatly separated from the tuned frequency. Its units are dB/decade (see M_2, p. 37).
S/I:	Degradation threshold. It is the minimum signal-to-interference ratio required for non-interference. Its units are dB (p. 43).
SP REJ:	Spurious response rejection. Its units are dB (p. 34).
TSO IND:	Technical Standard Order indicator. T = equipment is TSO'd., A = equipment is TSO'd and also falls under an ARINC characteristic (see pp. 10 and 11).

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A MODEL TO PREDICT MUTUAL INTERFERENCE EFFECTS ON AN AIRFRAME. (U)
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CONTENTS OF AVBASE

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**** AVBASE TRANSMITTERS ****

KEY NO.	NOMENCLATURE		LO FRQ MHZ.	HI FRQ MHZ.	TSO IND	BW1 MHZ.	BW2 MHZ.	SF1 D/B	SF2 D/B	PWR DBM	EB MHZ.	MOD TYP	PCI	PW USEC	R/F USEC	PRF MHZ.	LO FLT MHZ.	HI FLT MHZ.	N	HARMONIC SUPPR (DB) 2	3	4
5150	RT11A	C	118.	135.95	T	.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	80.	95.	0.
5151	RT11B	C	118.	135.95	T	.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	80.	95.	0.
5152	RT131A	C	118.	135.98	T	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5153	RT302A	C	118.	135.95	T	.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5154	RT302B	C	118.	135.95	T	.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5155	RT300C	C	118.	135.95		.006	.06	80.	20.	38.	.004	A3		.00	.000	0.	0.	0.	3	50.	80.	0.
5156	RT317A	C	118.	135.95	T	.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5157	RT317B	C	118.	135.95	T	.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5158	RT317B1	C	118.	135.95	T	.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5159	RT422A	C	118.	135.95	T	.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	40.	60.	0.
5160	RT432A	C	118.	135.95	T	.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	40.	60.	0.
5161	RT508A	C	118.	127.90		.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5162	RT513A	C	118.	126.90		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5163	RT514A	C	118.	135.90		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	74.	100.	0.
5164	RT514B	C	118.	135.90		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	74.	100.	0.
5165	RT514A1	C	118.	135.95		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	74.	100.	0.
5166	RT514B1	C	118.	135.95		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	74.	100.	0.
5167	RT516A	C	118.	126.90		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5168	RT517B	C	118.	126.90		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5169	RT522A	C	118.	135.95		.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	55.	90.	0.
5170	RT524A	C	118.	135.95		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	74.	100.	0.
5171	RT520A	C	118.	135.95	T	.006	.06	80.	20.	41.	.004	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
5172	RT526E	C	118.	135.95	T	.006	.06	80.	20.	41.	.004	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
5173	RT532A	C	118.	135.95	T	.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	55.	90.	0.
5174	RT532J	C	118.	135.95	T	.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	55.	90.	0.
5175	RT540	C	118.	135.95		.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	74.	100.	0.
5176	RT831A	C	118.	135.98	T	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	55.	90.	0.
5550	RT221A	C	118.	135.95		.006	.06	80.	20.	38.	.004	A3		.00	.000	0.	0.	0.	3	80.	110.	0.
5551	RT241A	C	118.	135.95	T	.006	.06	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	50.	80.	0.
5552	RTA41A	C	116.	149.95	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5553	RTA41B	C	116.	149.95	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5554	RTA42A	C	116.	149.98	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5555	RTA42B	C	116.	149.95	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	95.	0.
5556	TA20	C	118.	135.95	T	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	85.	110.	0.
5557	TA22	C	116.	149.95	T	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	75.	105.	0.
5950	VHF20	C	117.	135.98	T	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5951	VHF20	C	117.	135.98	T	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5952	17L7	C	118.	151.95	T	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5953	17L7A	C	118.	151.95	T	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5958	618M B3	C	118.	135.98	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5959	618M B4	C	118.	135.95	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5960	618M B4	C	118.	135.98	A	.006	.06	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5961	618M B1	C	116.	151.95	A	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5962	618M B2	C	116.	151.95	A	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5963	618M B4	C	116.	151.98	A	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5964	618M B5	C	116.	151.95	A	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5965	618M B5	C	116.	151.98	A	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5966	618M B6	C	116.	151.95	A	.006	.06	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.

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**** AVBASE TRANSMITTERS ****

KEY NO.	NOMENCLATURE		LO FRQ MHZ.	HI FRQ MHZ.	TSO IND	BW1 MHZ.	BW2 MHZ.	SF1 D/D	SF2 D/D	PWR DBM	EBW MHZ.	MOD TYP	PCI	PW USEC	R/F USEC	PRF PPS	LO FLT MHZ.	HI FLT MHZ.	N	HARMONIC SUPP(DB) 2	3	4
5967	610M1	C	110.	135.95	A	.006	.04	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	100.	125.	0.
5968	610M1A	C	116.	135.95	T	.006	.04	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	100.	125.	0.
5969	610M1B	C	110.	135.98	T	.006	.04	80.	20.	44.	.006	A3		.00	.000	0.	0.	0.	3	100.	125.	0.
5970	610M1C	C	116.	149.98	T	.006	.04	80.	20.	44.	.006	A3		.00	.000	0.	0.	0.	3	100.	125.	0.
5971	610M1D	C	110.	135.98	T	.006	.04	80.	20.	44.	.006	A3		.00	.000	0.	0.	0.	3	100.	125.	0.
5972	610M2B1	C	110.	135.95	A	.006	.04	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5973	610M2B6	C	110.	135.95	A	.006	.04	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5974	610M2B7	C	110.	135.95	A	.006	.04	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
5954	610F1A	C	110.	135.95	T	.006	.04	80.	20.	38.	.004	A3		.00	.000	0.	0.	0.	3	67.	67.	0.
5955	610F1B	C	117.	139.95	T	.006	.04	80.	20.	38.	.006	A3		.00	.000	0.	0.	0.	3	67.	67.	0.
5956	610F1C	C	110.	135.95	T	.006	.04	80.	20.	38.	.004	A3		.00	.000	0.	0.	0.	3	67.	67.	0.
5957	610F1D	C	117.	139.95	T	.006	.04	80.	20.	38.	.006	A3		.00	.000	0.	0.	0.	3	67.	67.	0.
6360	RT901CA	C	110.	135.95		.006	.04	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	50.	80.	0.
6361	SKY515A	C	110.	135.95		.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	45.	70.	0.
6750	RT553	C	110.	135.95		.006	.04	80.	20.	37.	.006	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
6751	RT661	C	110.	135.95	T	.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
6752	RT771	C	110.	135.95		.006	.04	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	100.	140.	0.
7150	A10	C	110.	135.95		.006	.04	80.	20.	35.	.004	A3		.00	.000	0.	0.	0.	3	65.	100.	0.
7151	A100	C	110.	135.95		.006	.04	80.	20.	35.	.004	A3		.00	.000	0.	0.	0.	3	65.	100.	0.
7152	A190	C	110.	126.90		.006	.04	80.	20.	40.	.006	A3		.00	.000	0.	0.	0.	3	65.	100.	0.
7153	A200	C	110.	126.90		.006	.04	80.	20.	35.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7154	A200A	C	110.	126.90		.006	.04	80.	20.	35.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7155	A300	C	110.	135.95		.006	.04	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	65.	100.	0.
7156	A300A	C	110.	135.95		.006	.04	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	65.	100.	0.
7157	A360	C	110.	135.95		.006	.04	80.	20.	35.	.006	A3		.00	.000	0.	0.	0.	3	65.	100.	0.
7158	A500	C	110.	135.95		.006	.04	80.	20.	35.	.004	A3		.00	.000	0.	0.	0.	3	45.	80.	0.
7159	A600	C	110.	135.95		.006	.04	80.	20.	38.	.004	A3		.00	.000	0.	0.	0.	3	30.	60.	0.
7550	KG200	C	110.	126.90		.004	.04	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	65.	80.	0.
7551	KG200A	C	110.	126.90		.006	.04	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	65.	80.	0.
7552	KTR900	C	110.	135.95	T	.006	.04	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7553	KTR900A	C	110.	135.95	T	.006	.04	80.	20.	43.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7554	KTR905	C	110.	135.98	T	.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	2	60.	0.	0.
7555	KTR9000	C	110.	135.95	A	.006	.04	80.	20.	44.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7556	KTR9100	C	110.	135.98	A	.006	.04	80.	20.	44.	.006	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7557	KTR9100A	C	110.	135.98	A	.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	2	60.	0.	0.
7558	KX150	C	110.	126.90		.006	.04	80.	20.	36.	.004	A3		.00	.000	0.	0.	0.	3	80.	100.	0.
7559	KX150A	C	110.	126.90		.006	.04	80.	20.	36.	.004	A3		.00	.000	0.	0.	0.	3	80.	100.	0.
7560	KX150B	C	110.	126.90		.006	.04	80.	20.	36.	.006	A3		.00	.000	0.	0.	0.	3	80.	100.	0.
7561	KX160	C	110.	135.95		.006	.04	80.	20.	36.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7562	KX170	C	110.	135.95		.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	65.	110.	0.
7563	KX170A	C	110.	135.95		.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7564	KX170B	C	110.	135.98		.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7565	KX170BE	C	110.	135.98		.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7566	KX175	C	110.	135.98	T	.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	70.	100.	0.
7567	KX175B	C	110.	135.98	T	.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7568	KX175BE	C	110.	135.98	T	.006	.04	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7569	KY90	C	110.	126.90		.006	.04	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	80.	90.	0.
7570	KY90A	C	110.	126.90		.006	.04	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	80.	90.	0.

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**** AVBASE TRANSMITTERS ****

KEY NO.	NOMENCLATURE		LO FRQ MHZ.	HI FRQ MHZ.	TSO IND	BW1 MHZ.	BW2 MHZ.	SP1 D/D	SP2 D/D	PWR DBM	BW MHZ.	MOD TYP	PCI	PW USEC	R/F USEC	PRF MHZ.	LO FLT MHZ.	HI FLT MHZ.	N	HARMONIC SUPPRESSION 2	3	4
7571	KY95	C	118.	136.95		.006	.06	80.	20.	41.	.006	A3		.00	.000	0.	0.	0.	3	90.	100.	0.
7572	KY195	C	118.	135.95	T	.006	.06	80.	20.	37.	.006	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7573	KY195B	C	118.	135.98	T	.006	.06	80.	20.	37.	.006	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7574	KY195BE	C	118.	135.98	T	.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	85.	105.	0.
7950	COM10	C	118.	135.95		.006	.06	80.	20.	37.	.006	A3		.00	.000	0.	0.	0.	3	25.	40.	0.
7951	COM10A	C	118.	135.95		.006	.06	80.	20.	38.	.004	A3		.00	.000	0.	0.	0.	3	25.	40.	0.
7952	COM11	C	118.	135.95		.006	.06	80.	20.	37.	.004	A3		.00	.000	0.	0.	0.	3	25.	40.	0.
7953	COM11A	C	118.	135.95		.006	.06	80.	20.	38.	.006	A3		.00	.000	0.	0.	0.	3	25.	40.	0.
7954	COM11B	C	118.	135.90		.006	.06	80.	20.	39.	.006	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
7955	COM110	C	118.	135.95	T	.006	.06	80.	20.	39.	.006	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
7956	COM111	C	118.	135.95	T	.006	.06	80.	20.	39.	.006	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
7957	COM111B	C	118.	135.98	T	.006	.06	80.	20.	39.	.004	A3		.00	.000	0.	0.	0.	3	50.	70.	0.
7958	ESCORT110	C	118.	135.90		.006	.06	80.	20.	38.	.006	A3		.00	.000	0.	0.	0.	3	40.	47.	0.
7959	MK3	C	118.	135.90		.006	.06	80.	20.	35.	.006	A3		.00	.000	0.	0.	0.	3	55.	70.	0.
7960	MK5	C	118.	135.90		.004	.06	80.	20.	37.	.006	A3		.00	.000	0.	0.	0.	3	60.	80.	0.
7961	MK6	C	118.	135.95		.006	.06	80.	20.	37.	.006	A3		.00	.000	0.	0.	0.	3	60.	80.	0.
7962	MK7	C	118.	135.95		.006	.06	80.	20.	39.	.006	A3		.00	.000	0.	0.	0.	3	55.	70.	0.
7963	MK8	C	118.	135.95		.006	.06	80.	20.	33.	.006	A3		.00	.000	0.	0.	0.	3	55.	70.	0.
7964	MK10	C	118.	135.95		.006	.06	80.	20.	39.	.004	A3		.40	.000	0.	0.	0.	3	55.	70.	0.
7965	MK12	C	118.	135.95		.006	.06	80.	20.	40.	.006	A3		.00	.000	0.	0.	0.	3	55.	70.	0.
7966	MK12B	C	118.	135.95		.006	.06	80.	20.	40.	.004	A3		.00	.000	0.	0.	0.	3	55.	70.	0.
7967	MK16	C	118.	135.95		.006	.06	80.	20.	40.	.006	A3		.00	.000	0.	0.	0.	3	40.	80.	0.
7968	MK24	C	118.	135.95	T	.006	.06	80.	20.	38.	.006	A3		.00	.000	0.	0.	0.	3	50.	80.	0.
8350	AVC11C	C	118.	135.95	T	.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	65.	75.	0.
8351	AVC11CA	C	118.	135.98	T	.006	.06	80.	20.	42.	.006	A3		.00	.000	0.	0.	0.	3	65.	75.	0.
8352	AVC111A	C	118.	135.98	T	.006	.06	80.	20.	42.	.006	A3		.00	.000	0.	0.	0.	3	65.	75.	0.
8750	807A	C	116.	149.98	T	.006	.06	80.	20.	45.	.006	A3		.00	.000	0.	0.	0.	3	70.	80.	0.
8751	1007A	C	118.	135.98	T	.006	.06	80.	20.	42.	.004	A3		.00	.000	0.	0.	0.	3	55.	75.	0.
5240	RT105A	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	57.	12.000	PO		.45	.097	0.	0.	0.	3	85.	130.	0.
5241	RT105B	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	57.	12.000	PO		.45	.097	0.	0.	0.	3	85.	130.	0.
5242	RT106A	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	57.	12.000	PO		.45	.097	0.	0.	0.	3	85.	130.	0.
5243	RT359A	ATC	1090.	1090.00	T	1.410	6.74	20.	40.	51.	11.600	PO		.04	.095	0.	0.	0.	3	75.	105.	0.
5244	RT459A	ATC	1090.	1090.00	T	1.410	6.74	20.	40.	54.	11.600	PO		.04	.095	0.	0.	0.	3	75.	105.	0.
5245	RT506A	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	54.	12.000	PO		.45	.097	0.	0.	0.	3	85.	130.	0.
5246	RT859A	ATC	1090.	1090.00	T	1.410	6.74	20.	40.	54.	11.600	PO		.04	.095	0.	0.	0.	3	75.	105.	0.
5640	TDR90	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	57.	12.000	PO		.45	.097	0.	0.	0.	2	70.	0.	0.
5641	TPR610	ATC	1090.	1090.00	T	1.410	6.50	20.	40.	53.	11.000	PO		.45	.100	0.	0.	0.	4	70.	105.	115.
5642	TPR640	ATC	1090.	1090.00		1.410	6.53	20.	40.	54.	12.000	PO		.45	.097	0.	0.	0.	3	80.	115.	0.
5643	TRA61A	ATC	1090.	1090.00	A	1.410	6.50	20.	40.	57.	11.000	PO		.45	.100	0.	0.	0.	4	60.	80.	95.
5644	TRA61AL	ATC	1090.	1090.00	A	1.410	6.50	20.	40.	57.	11.000	PO		.45	.100	0.	0.	0.	4	60.	80.	95.
5645	TRA61C	ATC	1090.	1090.00	A	1.410	6.50	20.	40.	57.	11.000	PO		.45	.100	0.	0.	0.	4	60.	80.	95.
5646	TRA63A	ATC	1090.	1090.00	A	1.410	6.53	20.	40.	57.	12.000	PO		.45	.097	0.	0.	0.	3	80.	110.	0.
5647	621A2	ATC	1090.	1090.00		1.410	6.50	20.	40.	57.	11.000	PO		.45	.100	0.	0.	0.	4	60.	80.	95.
5648	621A2A	ATC	1090.	1090.00		1.410	6.50	20.	40.	57.	11.000	PO		.45	.100	0.	0.	0.	4	60.	80.	95.
5649	621A3	ATC	1090.	1090.00	A	1.400	6.54	20.	40.	57.	12.000	PO		.43	.100	0.	0.	0.	4	90.	116.	116.
5650	621A6	ATC	1090.	1090.00	A	1.410	12.00	20.	40.	59.	12.000	PO		.45	.050	0.	0.	0.	4	75.	80.	100.
4840	RT667	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	56.	12.000	PO		.45	.097	0.	0.	0.	2	70.	0.	0.
4841	RT667A	ATC	1090.	1090.00	T	1.410	6.53	20.	40.	56.	12.000	PO		.45	.097	0.	0.	0.	2	70.	0.	0.

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**** AVBASE TRANSMITTERS ****

KEY NO.	NOMENCLATURE		LO FRQ MHZ.	HI FRQ MHZ.	TSQ IND	BW1 MHZ.	BW2 MHZ.	SF1 D/D	SF2 D/D	PWR DBM	EDB MHZ.	MOD TYP	PCI	PW USEC	R/F USEC	PRF MHZ.	LO FLT MHZ.	HI FLT MHZ.	B N	HARMONIC SUPP (DB) 2	3	4
6842	RT777	ATC	1090.	1090.00	T	1.910	6.53	20.	90.	56.	12.000	PO		.95	.097	0.	0.	0.	2	70.	0.	0.
7290	B500	ATC	1090.	1090.00		1.900	12.00	20.	90.	50.	12.000	PO		.95	.050	0.	0.	0.	9	60.	80.	100.
7291	B9096	ATC	1090.	1090.00	T	1.900	12.00	20.	90.	53.	12.000	PO		.95	.050	0.	0.	0.	9	60.	80.	100.
7292	B500C	ATC	1090.	1090.00	T	1.900	12.00	20.	90.	55.	12.000	PO		.95	.050	0.	0.	0.	9	60.	80.	100.
7690	KT75	ATC	1090.	1090.00	T	1.910	9.55	20.	90.	55.	12.000	PO		.95	.067	0.	0.	0.	3	89.	110.	0.
7691	KT75A	ATC	1090.	1090.00	T	1.910	9.55	20.	90.	55.	12.000	PO		.95	.067	0.	0.	0.	3	89.	110.	0.
7692	KT76	ATC	1090.	1090.00	T	1.910	10.90	20.	90.	53.	12.000	PO		.95	.058	0.	0.	0.	3	50.	60.	0.
7693	KT78	ATC	1090.	1090.00	T	1.910	10.90	20.	90.	50.	12.000	PO		.95	.067	0.	0.	0.	3	50.	60.	0.
7699	KXP75C	ATC	1090.	1090.00	T	1.910	9.55	20.	90.	55.	12.000	PO		.95	.047	0.	0.	0.	3	100.	120.	0.
7695	KXP75CA	ATC	1090.	1090.00	T	1.910	9.55	20.	90.	55.	12.000	PO		.95	.067	0.	0.	0.	3	100.	120.	0.
7696	KXP755	ATC	1090.	1090.00	T	1.910	6.55	20.	90.	55.	12.000	PO		.95	.097	0.	0.	0.	3	95.	65.	0.
8C90	AT5A	ATC	1090.	1090.00		1.910	6.53	20.	90.	52.	12.000	PO		.95	.097	0.	0.	0.	3	75.	110.	0.
8C91	AT6A	ATC	1090.	1090.00	T	1.910	6.53	20.	90.	52.	12.000	PO		.95	.097	0.	0.	0.	3	75.	110.	0.
8C92	AT50	ATC	1090.	1090.00	T	1.910	6.53	20.	90.	51.	12.000	PO		.95	.097	0.	0.	0.	3	80.	140.	0.
8C93	UAT1	ATC	1090.	1090.00	T	1.900	6.50	20.	90.	59.	11.000	PO		.95	.100	0.	0.	0.	3	60.	119.	0.
8990	AVQ60	ATC	1090.	1090.00	A	1.910	10.00	20.	90.	51.	12.000	PO		.95	.067	0.	0.	0.	3	80.	110.	0.
8991	AVQ65	ATC	1090.	1090.00	A	1.910	19.00	20.	90.	57.	12.000	PO		.95	.098	0.	0.	0.	3	80.	110.	0.
8992	AVQ95	ATC	1090.	1090.00	T	1.910	19.00	20.	90.	57.	12.000	PO		.95	.027	0.	0.	0.	3	80.	110.	0.
8E91	919	ATC	1090.	1090.00	A	1.910	12.00	20.	90.	57.	12.000	PO		.95	.050	0.	0.	0.	9	60.	80.	100.
8E92	1G19A	ATC	1090.	1090.00	T	1.910	19.30	20.	90.	59.	17.000	PO		.95	.099	0.	0.	0.	9	80.	90.	100.
5680	NOR1D	WR	9375.	9375.00	T	.250	2.56	20.	90.	72.	3.580	PO		2.50	.250	0.	6560.	15000.	2	60.	0.	0.
5681	NOR1E	WR	9375.	9375.00	A	.250	2.56	20.	90.	77.	3.580	PO		2.50	.250	0.	6540.	15000.	2	60.	0.	0.
5682	NOR1F	WR	9375.	9375.00	A	.128	2.56	20.	90.	78.	2.560	PO		5.00	.250	0.	6540.	15000.	2	60.	0.	0.
5683	NOR11C	WR	15500.	15500.00	T	.930	6.90	20.	90.	69.	7.000	PO		1.50	.100	0.	9490.	20000.	1	0.	0.	0.
5684	NOR19C	WR	9345.	9345.00	T	.180	.60	20.	60.	70.	1.000	PO		3.50	.150	0.	6540.	15000.	2	60.	0.	0.
5685	NOR1200	WR	9345.	9345.00	T	.180	.60	20.	60.	70.	1.000	PO		3.50	.150	0.	6540.	15000.	2	60.	0.	0.
6C80	WP103	WR	9375.	9375.00	T	.190	4.80	20.	90.	73.	9.000	PO		3.90	.133	900.	6540.	15000.	2	60.	0.	0.
6C91	WP103G	WR	9375.	9375.00	T	.190	4.80	20.	90.	73.	9.000	PO		3.90	.133	900.	6540.	15000.	2	60.	0.	0.
6C82	WXR8C	WR	9345.	9345.00	T	.120	9.25	20.	90.	75.	2.200	PO		5.50	.150	200.	6540.	15000.	2	60.	0.	0.
7680	KWX9C	WR	9375.	9375.00	T	.212	2.12	20.	90.	69.	2.900	PO		3.00	.300	0.	6540.	15000.	2	60.	0.	0.
8980	AVQ10	WR	5900.	5900.00	T	.318	9.77	20.	90.	79.	9.770	PO		2.00	.133	0.	3700.	15000.	2	60.	0.	0.
8981	AVQ20	WR	9375.	9375.00	T	.318	9.77	20.	90.	73.	9.770	PO		2.00	.133	0.	6540.	15000.	2	60.	0.	0.
8982	AVQ20A	WR	9375.	9375.00	T	.318	9.77	20.	90.	73.	9.770	PO		2.00	.133	0.	6540.	15000.	2	60.	0.	0.
8983	AVQ21	WR	9345.	9345.00	T	.180	3.20	20.	90.	69.	3.200	PO		3.50	.200	0.	6540.	15000.	2	80.	0.	0.
8989	AVQ30C	WR	5900.	5900.00	A	.106	2.20	20.	90.	79.	2.200	PO		6.00	.300	0.	9300.	15000.	2	100.	0.	0.
8985	AVQ30X	WR	9345.	9345.00	A	.111	2.90	20.	90.	78.	2.200	PO		5.75	.250	0.	6540.	15000.	2	80.	0.	0.
8986	AVQ95	WR	9375.	9375.00		.282	2.39	20.	90.	69.	3.000	PO		2.25	.266	0.	6540.	15000.	2	60.	0.	0.
8987	AVQ96	WR	9375.	9375.00	T	.282	2.39	20.	90.	69.	3.000	PO		2.25	.266	0.	6540.	15000.	2	60.	0.	0.
8988	AVQ97	WR	9375.	9375.00	T	.282	2.39	20.	90.	69.	3.000	PO		2.25	.266	0.	6540.	15000.	2	60.	0.	0.
8989	AVQ50	WR	9375.	9375.00		.318	9.77	20.	90.	75.	9.770	PO		2.00	.133	0.	6540.	15000.	2	60.	0.	0.
8990	AVQ55	WR	9375.	9375.00	A	.318	9.77	20.	90.	72.	9.770	PO		2.00	.133	0.	6540.	15000.	2	60.	0.	0.
6120	DME90	DME	1025.	1150.00	T	.300	7.00	60.	20.	55.	.800	PO		3.50	1.750	0.	0.	0.	3	70.	90.	0.
6121	860E3	DME	1025.	1150.00	A	.390	7.98	60.	20.	60.	.920	PO		3.00	1.800	0.	0.	0.	9	90.	90.	90.
7720	KDM700	DME	1091.	1150.00	T	.390	7.50	60.	20.	97.	.900	PO		3.50	2.500	0.	0.	0.	9	30.	35.	90.
7721	KDM70CA	DME	1091.	1150.00	T	.390	7.50	60.	20.	97.	.900	PO		3.50	2.500	0.	0.	0.	9	30.	35.	90.
7722	KDM705	DME	1091.	1150.00	T	.300	7.00	60.	20.	57.	.900	PO		3.80	1.750	0.	0.	0.	2	60.	0.	0.
7723	KDM705A	DME	1091.	1150.00	T	.300	7.00	60.	20.	60.	.900	PO		3.50	1.750	0.	0.	0.	2	60.	0.	0.
7729	KDM7000	DME	1091.	1150.00	A	.390	7.00	60.	20.	57.	.900	PO		3.50	2.500	0.	0.	0.	9	70.	80.	100.

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**** AVBASE TRANSMITTERS ****

KEY NO.	NOMENCLATURE		LO FRQ MHZ.	HI FRQ MHZ.	TSO IND	BW1 MHZ.	BW2 MHZ.	SF1 D/D	SF2 D/D	PWR DBM	EPW MHZ.	MOD TYP	PCI	PW USEC	R/F USEC	PRF MHZ.	LO FLT MHZ.	HI FLT MHZ.	# H	HARMONIC SUPP(DB) 2	3	4
7725	KN60	DME	1091.	1150.00		.390	7.50	60.	20.	96.	.900	PO		3.50	2.500	0.	0.	0.	4	30.	35.	40.
7726	KN60B	DME	1091.	1150.00		.390	7.50	60.	20.	96.	.900	PO		3.50	2.500	0.	0.	0.	4	30.	35.	40.
7727	KN60C	DME	1091.	1150.00		.390	7.50	60.	20.	96.	.900	PO		3.50	2.500	0.	0.	0.	4	30.	35.	40.
7728	KN65	DME	1091.	1150.00		.300	7.00	60.	20.	50.	.900	PO		3.50	2.500	0.	0.	0.	4	60.	80.	100.
8120	DME70	DME	1091.	1150.00		.390	7.50	60.	20.	44.	.900	PO		3.50	2.500	0.	0.	0.	3	42.	48.	0.
8121	DME190	DME	1091.	1150.00		.300	7.80	40.	20.	50.	.800	PO		3.50	1.750	0.	0.	0.	2	60.	0.	0.
8122	VD12A	DME	1091.	1150.00	T	.390	7.50	60.	20.	47.	.900	PO		3.50	2.500	0.	0.	0.	4	30.	35.	38.
8123	VD12AR	DME	1091.	1150.00	T	.390	7.50	60.	20.	44.	.900	PO		3.50	2.500	0.	0.	0.	4	30.	35.	38.
8124	VD13	DME	1091.	1150.00		.390	7.50	60.	20.	44.	.900	PO		3.50	2.500	0.	0.	0.	3	42.	50.	0.
8125	VD14	DME	1091.	1150.00		.390	7.50	60.	20.	44.	.900	PO		3.50	2.500	0.	0.	0.	4	30.	35.	38.
8520	AVQ70	DME	1091.	1150.00	A	.390	7.50	60.	20.	60.	.900	PO		3.50	2.500	0.	0.	0.	4	70.	100.	120.
8521	AVQ75	DME	1091.	1150.00	T	.390	7.50	60.	20.	60.	.900	PO		3.50	2.500	0.	0.	0.	4	70.	90.	100.
8522	AVQ85	DME	1091.	1150.00	A	.390	7.50	60.	20.	59.	.900	PO		3.50	2.000	0.	0.	0.	4	80.	100.	100.
5760	ALA51	ALT	4300.	4300.00	A	190.000	300.00	400.	20.	26.	190.000	F9		.00	.000	0.	70.	10000.	2	70.	0.	0.
6160	AL101	ALT	4300.	4300.00	A	100.000	340.00	140.	40.	27.	100.000	F2		.00	.000	0.	70.	10000.	2	80.	0.	0.
6161	ALT50	ALT	4300.	4300.00	A	98.400	210.00	300.	40.	22.	100.000	F2		.00	.000	0.	70.	10000.	2	80.	0.	0.

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**** AVBASE RECEIVERS ****

REF NO	NOMENCLATURE	CLASS		LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRQ MHZ.	HI SPR FRQ MHZ.	LO POS	SENS DBM.	S/I DB
152	RT121A	C	1	110.00	135.90	.034	23.0	T	190.0	120.0	70.0	60.0	80.	180.	A	-101.	10.
159	RT922A	C	1	110.00	135.95	.028	9.5	T	200.0	40.0	50.0	70.0	80.	180.	A	-97.	10.
160	RT932A	C	1	110.00	135.95	.028	9.5	T	200.0	60.0	50.0	70.0	80.	180.	A	-97.	10.
172	RT532A	C	1	110.00	135.95	.030	9.5	T	220.0	60.0	60.0	80.0	80.	180.	A	-101.	10.
173	RT532J	C	1	110.00	135.95	.030	9.5	T	220.0	60.0	60.0	80.0	80.	180.	A	-101.	10.
553	RN242A	C	1	110.00	127.95	.036	10.7	T	150.0	80.0	70.0	80.0	.1	400.	B	-97.	10.
175	RT821A(L)	C	1	110.00	135.90	.034	23.0	T	210.0	140.0	20.0	60.0	80.	180.	A	-101.	10.
179	RT821A(H)	C	1	110.00	135.90	.021	23.0	T	300.0	140.0	20.0	60.0	80.	180.	A	-101.	10.
1752	RT771	C	1	110.00	135.95	.028	20.0		230.0	100.0	22.0	70.0	.1	240.	A	-101.	10.
1351	SKY515A	C	1	110.00	135.95	.033	13.5		190.0	90.0	70.0	85.0	.1	440.	A	-101.	10.
555	RT241A	C	1	110.00	135.95	.028	10.7	T	190.0	80.0	70.0	80.0	90.	165.	A	-101.	10.
2150	A10	C	1	110.00	135.95	.024	23.4		106.0	95.0	30.0	60.0	20.	240.	A	-101.	10.
2151	A100	C	1	110.00	135.95	.024	23.4		106.0	95.0	30.0	60.0	20.	240.	A	-101.	10.
2152	A190	C	1	110.00	126.90	.032	22.9		65.0	95.0	28.0	60.0	20.	230.	A	-101.	10.
2153	A200	C	1	110.00	126.90	.032	22.9		75.0	95.0	28.0	60.0	20.	230.	A	-101.	10.
2154	A200A	C	1	110.00	126.90	.032	22.9		75.0	95.0	28.0	60.0	20.	230.	A	-101.	10.
2155	A300	C	1	110.00	135.95	.032	31.0		75.0	95.0	35.0	60.0	40.	215.	A	-101.	10.
2156	A300A	C	1	110.00	135.95	.032	31.0		75.0	95.0	35.0	60.0	40.	215.	A	-101.	10.
2157	A340	C	1	110.00	135.95	.033	23.4		77.0	95.0	30.0	60.0	20.	240.	A	-101.	10.
2158	A500	C	1	110.00	135.95	.026	22.5		95.0	100.0	10.0	60.0	1.	270.	A	-101.	10.
2159	A600	C	1	110.00	135.95	.024	22.9		95.0	95.0	10.0	50.0	50.	200.	A	-101.	10.
2563	KX170	C	1	110.00	135.95	.030	9.0		130.0	80.0	65.0	78.0	90.	140.	C	-97.	10.
2958	ESCORT110	C	1	110.00	128.90	.050	26.0		70.0	100.0	23.0	58.0	23.	220.	A	-101.	10.
2959	MK3	C	1	110.00	126.90	.034	9.5		80.0	90.0	40.0	85.0	.1	330.	A	-107.	10.
2963	MK8	C	1	110.00	126.90	.034	9.5		80.0	90.0	40.0	85.0	.1	330.	A	-99.	10.
155	RT308C	C	2	110.00	135.95	.030	10.8		200.0	80.0	70.0	95.0	100.	140.	A	-97.	10.
170	RT520A	C	2	110.00	135.95	.028	10.8	T	190.0	77.0	70.0	96.0	70.	180.	A	-101.	10.
171	RT520E	C	2	110.00	135.95	.028	10.8	T	190.0	77.0	70.0	96.0	70.	180.	A	-101.	10.
175	15F R34A	C	2	110.00	126.90	.042	12.6	T	110.0	60.0	70.0	100.0	30.	200.	B	-87.	10.
176	156 R36A	C	2	110.00	135.95	.028	12.6	T	200.0	76.0	75.0	100.0	40.	190.	B	-87.	10.
177	210 RT11A	C	2	110.00	135.95	.026	12.6	T	136.0	60.0	66.0	97.0	70.	210.	B	-101.	10.
178	210 RT11B	C	2	110.00	135.95	.026	12.6	T	134.0	60.0	66.0	97.0	70.	210.	B	-101.	10.
554	RT221A	C	2	110.00	135.95	.027	20.0	T	195.0	60.0	73.0	95.0	20.	200.	A	-101.	10.
556	RTA41A	C	2	116.00	149.95	.037	17.0	A	160.0	77.0	84.0	100.0	70.	200.	B	-97.	10.
557	RTA41B	C	2	116.00	149.95	.037	17.0	A	160.0	77.0	84.0	100.0	70.	200.	B	-97.	10.
950	VHF20	C	2	117.00	135.95	.016	20.0	T	220.0	60.0	72.0	100.0	.1	240.	A	-101.	10.
951	VHF20	C	2	117.00	135.90	.016	20.0	T	220.0	60.0	72.0	100.0	.1	240.	A	-101.	10.
960	SLX3	C	2	110.00	126.90	.028	10.4	T	80.0	40.0	70.0	104.0	.1	280.	B	-93.	10.
1355	RT9010A	C	2	110.00	135.95	.028	10.7		180.0	80.0	70.0	90.0	80.	170.	C	-107.	10.
1750	RT553	C	2	110.00	135.95	.038	9.3		115.0	80.0	60.0	90.0	70.	180.	A	-97.	10.
1751	RT641	C	2	110.00	135.95	.023	9.3		110.0	80.0	60.0	90.0	70.	180.	A	-97.	10.
2550	KTR900	C	2	110.00	135.95	.034	10.7	T	230.0	60.0	70.0	94.0	80.	180.	B	-97.	10.
2551	KTR900A	C	2	110.00	135.90	.027	9.0	T	220.0	80.0	70.0	100.0	80.	170.	B	-97.	10.
2552	KTR905	C	2	110.00	135.90	.017	10.0	T	210.0	80.0	70.0	100.0	80.	170.	B	-97.	10.
2553	KTR900B	C	2	110.00	135.90	.027	9.0	A	220.0	60.0	70.0	100.0	80.	170.	B	-97.	10.
2554	KTR9100AS	C	2	110.00	135.90	.024	10.0	A	240.0	80.0	70.0	100.0	80.	170.	B	-97.	10.
2555	KTR9100AL	C	2	110.00	135.90	.030	10.0	A	240.0	80.0	70.0	100.0	80.	170.	B	-97.	10.
2559	KX190	C	2	110.00	126.90	.032	33.9		190.0	60.0	84.0	104.0	.1	280.	B	-101.	10.

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****** AVBASE RECEIVERS ******

REF NO	NOMENCLATURE	CLASS		LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRQ MHZ.	HI SPR FRQ MHZ.	LO POS	SENS DBM.	S/I DB.
2540	KX150A	C	2	118.00	126.90	.032	33.9		140.0	40.0	89.0	106.0	.1	280.	B	-101.	10.
2541	KX150B	C	2	118.00	126.90	.032	33.9		140.0	40.0	89.0	106.0	.1	280.	B	-101.	10.
2542	KX160	C	2	118.00	135.95	.024	34.0		110.0	40.0	85.0	106.0	.1	290.	B	-101.	10.
2544	KX170A	C	2	118.00	135.95	.027	9.0		110.0	74.0	70.0	100.0	75.	180.	C	-97.	10.
2545	KX170B	C	2	118.00	135.90	.013	9.0		85.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2546	KX170BE	C	2	118.00	135.90	.027	9.0		110.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2547	KX175	C	2	118.00	135.95	.027	9.0	T	140.0	40.0	70.0	100.0	75.	180.	C	-97.	10.
2548	KX175B	C	2	118.00	135.90	.013	9.0	T	140.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2549	KX175BE	C	2	118.00	135.90	.027	9.0	T	110.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2570	KY195	C	2	118.00	135.95	.027	9.0	T	110.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2571	KY195B	C	2	118.00	135.90	.013	9.0	T	140.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2572	KY195BE	C	2	118.00	135.90	.027	9.0	T	110.0	75.0	70.0	100.0	75.	180.	C	-97.	10.
2950	COM10	C	2	118.00	135.95	.030	12.0		115.0	40.0	60.0	95.0	10.	235.	A	-94.	10.
2951	COM10A	C	2	118.00	135.95	.030	12.0		115.0	40.0	60.0	95.0	10.	235.	A	-94.	10.
2952	COM11	C	2	118.00	135.95	.030	12.0		115.0	40.0	60.0	95.0	10.	235.	A	-94.	10.
2953	COM11A	C	2	118.00	135.95	.030	12.0		115.0	40.0	60.0	95.0	10.	235.	A	-94.	10.
2954	COM11B	C	2	118.00	135.90	.020	12.0		220.0	40.0	60.0	90.0	40.	220.	A	-103.	10.
2955	COM110	C	2	118.00	135.95	.032	12.0	T	200.0	40.0	60.0	90.0	30.	220.	A	-99.	10.
2956	COM111	C	2	118.00	135.95	.032	12.0	T	200.0	40.0	60.0	90.0	30.	220.	A	-99.	10.
2957	COM111B	C	2	118.00	135.90	.020	12.0	T	220.0	40.0	60.0	90.0	40.	220.	A	-104.	10.
2959	MK12	C	2	118.00	135.95	.028	9.5		120.0	40.0	62.0	95.0	50.	200.	A	-104.	10.
2960	MK12B	C	2	118.00	135.95	.028	9.5		120.0	40.0	62.0	95.0	50.	200.	A	-103.	10.
2961	MK16	C	2	118.00	135.95	.034	28.0		230.0	40.0	70.0	90.0	50.	200.	A	-103.	10.
2962	MK24	C	2	118.00	135.95	.030	10.5	T	170.0	40.0	70.0	93.0	30.	220.	A	-103.	10.
3350	AVC110	C	2	118.00	135.95	.026	14.0	T	160.0	40.0	86.0	100.0	10.	250.	A	-105.	10.
3351	AVC110A	C	2	118.00	135.90	.018	14.0	T	220.0	40.0	86.0	100.0	10.	250.	A	-105.	10.
3352	AVC111A	C	2	118.00	135.90	.018	14.0	T	220.0	40.0	86.0	100.0	10.	250.	A	-105.	10.
3750	807A	C	2	118.00	149.90	.028	20.0	T	160.0	40.0	65.0	90.0	30.	235.	B	-97.	10.
3751	1005A	C	2	118.00	127.95	.028	20.0	T	160.0	40.0	79.0	90.0	.1	290.	B	-100.	10.
3752	1005B	C	2	118.00	127.95	.028	20.0	T	160.0	40.0	79.0	90.0	.1	290.	B	-100.	10.
3753	1006A	C	2	118.00	127.95	.028	20.0	T	160.0	40.0	79.0	90.0	.1	290.	B	-100.	10.
3754	1006B	C	2	118.00	127.95	.028	20.0	T	160.0	40.0	79.0	90.0	.1	290.	B	-100.	10.
3755	1007A	C	2	118.00	135.90	.028	20.0	T	160.0	40.0	79.0	90.0	.1	290.	B	-100.	10.
150	R219A	C	3	118.00	126.95	.036	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-75.	10.
151	R219B1	C	3	118.00	126.95	.036	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-75.	10.
153	RT302A	C	3	118.00	135.95	.027	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-97.	10.
154	RT302B	C	3	118.00	135.95	.027	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-97.	10.
156	RT317A	C	3	118.00	126.95	.036	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-81.	10.
157	RT317B	C	3	118.00	126.95	.036	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-81.	10.
158	RT317B1	C	3	118.00	126.95	.036	20.6	T	136.0	40.0	72.0	110.0	.1	306.	B	-81.	10.
161	RT508A	C	3	118.00	126.90	.033	14.0		230.0	77.0	90.0	125.0	40.	190.	B	-101.	10.
162	RT513A	C	3	118.00	126.90	.030	32.0		80.0	40.0	83.0	120.0	.1	190.	B	-87.	10.
163	RT514A	C	3	118.00	135.90	.020	33.4		87.0	42.0	62.0	116.0	.1	1200.	B	-101.	10.
164	RT514B	C	3	118.00	135.95	.020	33.4		87.0	42.0	62.0	116.0	.1	1200.	B	-101.	10.
165	RT514A1	C	3	118.00	135.95	.020	33.4		87.0	42.0	62.0	116.0	.1	1200.	B	-101.	10.
166	RT514B1	C	3	118.00	135.95	.020	33.4		87.0	42.0	62.0	116.0	.1	1200.	B	-101.	10.
167	RT516A	C	3	118.00	126.90	.020	33.4		87.0	40.0	85.0	120.0	.1	730.	B	-101.	10.
168	RT517B	C	3	118.00	126.90	.020	33.4		87.0	40.0	85.0	120.0	.1	730.	B	-101.	10.

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****** AVBASE RECEIVERS ******

KEY NO	NOMENCLATURE	CLASS		LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRG MHZ.	HI SPR FRG MHZ.	LO POS	SENS DBM.	S/I DB
169	RT529A	C	3	118.00	135.95	.020	33.9		57.0	92.0	62.0	116.0	1.	1200.	B	-103.	10.
550	MN85	C	3	118.00	135.90	.090	50.2		110.0	60.0	96.0	130.0	1.	490.	B	-97.	10.
551	RA21A	C	3	118.00	135.95	.038	49.2	T	220.0	100.0	140.0	140.0	1.	290.	B	-97.	10.
552	RA22B	C	3	118.00	135.95	.038	17.0	T	220.0	77.0	86.0	110.0	40.	210.	B	-97.	10.
558	RTA42A	C	3	116.00	149.98	.017	16.2	A	160.0	77.0	90.0	117.0	46.	220.	B	-97.	10.
559	RTA42B	C	3	116.00	149.95	.028	16.2	A	240.0	77.0	90.0	117.0	46.	220.	B	-97.	10.
952	51R3	C	3	118.00	135.90	.090	21.3		100.0	60.0	75.0	110.0	1.	300.	B	-97.	10.
953	51R7	C	3	118.00	126.95	.098	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	10.
954	51R7A	C	3	118.00	126.95	.098	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	10.
955	51R8	C	3	118.00	126.95	.098	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	10.
956	51R8A	C	3	118.00	126.95	.098	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	10.
957	51X2	C	3	118.00	151.95	.031	12.0	T	175.0	80.0	82.0	110.0	60.	190.	B	-101.	10.
958	51X2B	C	3	118.00	151.95	.031	12.0	T	175.0	80.0	82.0	110.0	60.	190.	B	-101.	10.
959	51X2C	C	3	118.00	135.95	.031	12.0	T	175.0	80.0	82.0	110.0	60.	190.	B	-101.	10.
961	618F1A	C	3	118.00	135.95	.090	12.5	T	200.0	60.0	70.0	125.0	1.	340.	A	-97.	10.
962	618F1B	C	3	117.00	134.95	.090	12.5	T	200.0	60.0	70.0	125.0	1.	340.	A	-97.	10.
963	618F1C	C	3	118.00	135.95	.090	12.5	T	200.0	40.0	70.0	125.0	1.	340.	A	-97.	10.
964	618F1D	C	3	117.00	134.95	.090	12.5	T	200.0	60.0	70.0	125.0	1.	340.	A	-97.	10.
965	618M1	C	3	118.00	135.95	.038	12.5	A	265.0	80.0	80.0	112.0	60.	200.	A	-101.	10.
966	618M1A	C	3	116.00	149.95	.038	12.5	T	265.0	80.0	80.0	112.0	60.	200.	A	-101.	10.
967	618M1B	C	3	118.00	135.98	.018	12.5	T	235.0	80.0	80.0	112.0	60.	200.	A	-101.	10.
968	618M1C	C	3	116.00	149.98	.018	12.5	T	235.0	80.0	80.0	112.0	40.	200.	A	-101.	10.
969	618M1D	C	3	118.00	135.98	.018	12.5	T	235.0	80.0	80.0	112.0	40.	200.	A	-101.	10.
970	618M2A1	C	3	118.00	135.95	.028	18.5	A	195.0	80.0	90.0	115.0	35.	220.	B	-102.	10.
971	618M2A3	C	3	118.00	135.98	.016	18.5	A	180.0	80.0	90.0	115.0	35.	220.	B	-102.	10.
972	618M2B4	C	3	118.00	135.95	.034	18.5	A	255.0	80.0	90.0	115.0	35.	220.	B	-102.	10.
973	618M2P4	C	3	118.00	135.98	.017	18.5	A	260.0	80.0	90.0	115.0	35.	220.	B	-102.	10.
974	618M2B6	C	3	118.00	135.95	.028	18.5	A	195.0	80.0	90.0	115.0	35.	220.	B	-104.	10.
975	618M2B7	C	3	118.00	135.95	.028	18.5	A	195.0	80.0	90.0	115.0	35.	220.	B	-102.	10.
976	618M2D1	C	3	116.00	151.95	.028	18.5	A	190.0	80.0	90.0	115.0	35.	235.	B	-102.	10.
977	618M2D2	C	3	116.00	151.95	.028	18.5	A	190.0	80.0	90.0	115.0	35.	235.	B	-102.	10.
978	618M2D4	C	3	116.00	151.98	.016	18.5	A	180.0	80.0	90.0	115.0	35.	235.	B	-102.	10.
979	618M2D5	C	3	116.00	151.95	.034	18.5	A	255.0	80.0	90.0	115.0	35.	235.	B	-102.	10.
980	618M2D5	C	3	116.00	151.98	.017	18.5	A	260.0	80.0	90.0	115.0	35.	235.	B	-102.	10.
981	618M2D6	C	3	116.00	151.95	.038	18.5	A	235.0	80.0	90.0	115.0	35.	235.	B	-102.	10.
2556	KY90	C	3	118.00	126.95	.058	31.9		140.0	60.0	77.0	114.0	1.	400.	B	-101.	10.
2557	KY90A	C	3	118.00	126.95	.058	31.9		140.0	60.0	77.0	114.0	1.	400.	B	-101.	10.
2558	KY95	C	3	118.00	136.95	.029	35.9		140.0	60.0	78.0	124.0	1.	440.	B	-101.	10.
2960	MK5	C	3	118.00	126.90	.036	26.0		90.0	60.0	80.0	110.0	1.	300.	B	-103.	10.
2961	MK6	C	3	118.00	126.90	.036	26.9		90.0	60.0	80.0	110.0	1.	300.	B	-101.	10.
2962	MK7	C	3	118.00	126.95	.031	36.2		170.0	60.0	80.0	120.0	1.	300.	B	-103.	10.
2964	MK10	C	3	118.00	126.95	.031	36.2		170.0	60.0	80.0	120.0	1.	300.	B	-103.	10.
102	RS42A	VL	1	108.00	117.90	.038	13.5	T	220.0	60.0	60.0	80.0	50.	180.	A	-101.	20.
103	RS42J	VL	1	108.00	117.90	.038	13.5	T	220.0	60.0	60.0	80.0	50.	180.	A	-101.	20.
108	RT422A	VL	1	108.00	117.95	.038	13.5	T	220.0	60.0	60.0	80.0	50.	170.	A	-97.	20.
107	RN242A	VL	1	108.00	117.95	.036	10.7	T	180.0	80.0	70.0	80.0	1.	400.	B	-97.	20.
109	RT442A	VL	1	108.00	117.95	.038	13.5	T	220.0	60.0	60.0	80.0	50.	170.	A	-97.	20.
1703	RT772	VL	1	108.00	117.95	.032	15.5		190.0	77.0	23.0	70.0	1.	360.	B	-101.	20.

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**** AVBASE RECEIVERS ****

KEY NO	NOMENCLATURE		CLASS	LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSQ IND	IF SP DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LC SPH FRG MHZ.	HI SPR FRQ MHZ.	LO PCS	SENS DBM.	S/I DB
2100	A190	VL	1	108.00	117.90	.032	30.9		65.0	95.0	40.0	60.0	10.	220.	A	-101.	40.
2101	A200	VL	1	108.00	117.90	.032	30.9		75.0	95.0	40.0	60.0	10.	230.	A	-101.	40.
2102	A200A	VL	1	108.00	117.90	.032	30.9		75.0	95.0	40.0	60.0	10.	230.	A	-101.	20.
2103	A300	VL	1	108.00	117.95	.032	31.0		75.0	95.0	40.0	60.0	30.	200.	A	-101.	40.
2104	A300A	VL	1	108.00	117.95	.032	31.0		75.0	95.0	35.0	60.0	40.	215.	A	-101.	40.
2105	A360	VL	1	108.00	117.90	.024	31.2		65.0	95.0	42.0	60.0	10.	220.	A	-101.	40.
2106	A500	VL	1	108.00	117.95	.026	30.5		95.0	100.0	15.0	65.0	1.	290.	A	-101.	40.
2107	A600	VL	1	108.00	117.95	.026	31.0		100.0	100.0	40.0	60.0	60.	170.	A	-101.	40.
2515	KX150	VL	1	108.00	117.90	.026	26.0		70.0	74.0	67.0	78.0	50.	175.	B	-101.	20.
2516	KX150A	VL	1	108.00	117.90	.026	26.0		70.0	74.0	67.0	78.0	50.	175.	B	-101.	20.
2517	KX150B	VL	1	108.00	117.90	.026	26.0		70.0	74.0	67.0	78.0	50.	175.	B	-101.	20.
2518	KX160	VL	1	108.00	117.95	.031	26.0		75.0	75.0	67.0	80.0	50.	180.	B	-101.	40.
2904	ESCORTIIC	VL	1	108.00	117.90	.050	38.0		70.0	100.0	40.0	56.0	15.	210.	A	-101.	20.
2912	MK16	VL	1	108.00	117.90	.030	16.0		80.0	60.0	60.0	80.0	40.	140.	B	-107.	40.
2913	MK24	VL	1	108.00	117.90	.036	16.9	T	95.0	90.0	50.0	80.0	60.	170.	B	-97.	20.
118	15F R34A	VL	2	108.00	117.90	.042	12.6	T	110.0	60.0	70.0	100.0	30.	240.	B	-87.	40.
119	156 R35A	VL	2	108.00	117.95	.036	12.6	T	200.0	74.0	75.0	100.0	60.	190.	B	-87.	40.
504	RN222A	VL	2	108.00	117.90	.038	20.0		230.0	60.0	73.0	95.0	20.	200.	A	-101.	40.
505	RN222AF	VL	2	108.00	136.95	.038	20.0		230.0	60.0	73.0	95.0	20.	200.	A	-101.	40.
506	RNA26C	VL	2	108.00	117.95	.090	49.0	A	200.0	80.0	100.0	100.0	90.	130.	B	-101.	20.
913	FLX3	VL	2	108.00	117.90	.028	16.9	T	80.0	60.0	70.0	104.0	1.	280.	B	-93.	20.
1700	R552	VL	2	108.00	117.95	.034	17.0		100.0	80.0	80.0	100.0	60.	160.	B	-99.	20.
1701	R662	VL	2	108.00	117.95	.034	17.0		104.0	80.0	60.0	100.0	60.	140.	B	-101.	20.
1702	RT553	VL	2	108.00	117.95	.030	9.3		115.0	80.0	60.0	90.0	70.	180.	A	-97.	20.
2501	KNR600	VL	2	108.00	117.95	.029	25.5	T	155.0	80.0	78.0	100.0	1.	320.	B	-101.	40.
2502	KNR600A	VL	2	108.00	117.95	.029	25.5	T	155.0	80.0	78.0	100.0	1.	320.	B	-101.	20.
2503	KNR601	VL	2	108.00	117.95	.029	25.5	T	155.0	80.0	78.0	100.0	1.	320.	B	-101.	40.
2504	KNR615	VL	2	108.00	117.95	.034	15.2	T	140.0	80.0	95.0	100.0	50.	180.	B	-101.	20.
2505	KNR630	VL	2	108.00	117.95	.034	15.2	T	140.0	80.0	95.0	100.0	50.	180.	B	-101.	20.
2506	KNR631	VL	2	108.00	117.95	.034	15.2	T	140.0	80.0	95.0	100.0	50.	180.	B	-101.	40.
2507	KNR632	VL	2	108.00	117.95	.034	15.2	T	140.0	80.0	95.0	100.0	50.	180.	B	-101.	20.
2508	KNR660	VL	2	108.00	117.95	.029	25.5	T	155.0	80.0	78.0	100.0	1.	320.	B	-101.	20.
2509	KNR660A	VL	2	108.00	117.95	.029	25.5	T	155.0	80.0	78.0	100.0	1.	320.	B	-101.	20.
2510	KNR661	VL	2	108.00	117.95	.029	25.5	T	155.0	80.0	78.0	100.0	1.	320.	B	-101.	40.
2511	KNR665	VL	2	108.00	117.95	.034	15.2		140.0	80.0	95.0	100.0	50.	180.	B	-101.	20.
2519	KX170	VL	2	108.00	117.95	.035	15.2		145.0	80.0	82.0	95.0	60.	140.	C	-97.	20.
2520	KX170A	VL	2	108.00	117.95	.035	15.2		106.0	60.0	70.0	100.0	10.	210.	B	-97.	20.
2521	KX170B	VL	2	108.00	117.95	.035	15.2		106.0	60.0	70.0	100.0	10.	210.	B	-97.	20.
2522	KX170BE	VL	2	108.00	117.95	.035	15.2	T	106.0	60.0	70.0	100.0	10.	210.	B	-97.	40.
2523	KX175	VL	2	108.00	117.95	.035	15.2	T	160.0	60.0	70.0	100.0	10.	210.	B	-97.	20.
2524	KX175B	VL	2	108.00	117.95	.035	15.2	T	106.0	60.0	70.0	100.0	10.	210.	B	-97.	20.
2525	KX175BE	VL	2	108.00	117.95	.035	15.2	T	106.0	60.0	70.0	100.0	10.	210.	B	-97.	40.
2900	COM10	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	240.	A	-99.	20.
2901	COM10A	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	240.	A	-99.	20.
2902	COM11	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	240.	A	-99.	20.
2903	COM11A	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	240.	A	-99.	20.
105	RT317A	VL	3	108.00	117.95	.036	20.0	T	136.0	60.0	72.0	110.0	1.	306.	B	-81.	20.
2905	MK3	VL	2	108.00	117.90	.034	17.8		80.0	90.0	50.0	100.0	1.	630.	A	-107.	20.

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**** AVBASE RECEIVERS ****

KEY NO	NOMENCLATURE		CLASS	LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRG MHZ.	HI SPR FRG MHZ.	LO POS	SENS DBM.	S/I DB.
2908	MK8	VL	2	108.00	117.90	.034	17.5		80.0	40.0	55.0	100.0	1.	630.	A	-103.	20.
2910	MK12	VL	2	108.00	117.90	.036	12.3		85.0	60.0	70.0	105.0	10.	220.	B	-107.	20.
2911	MK12D	VL	2	108.00	117.90	.017	12.3		80.0	60.0	70.0	105.0	10.	220.	B	-107.	20.
2914	NAV11	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	220.	A	-94.	20.
2915	NAV12	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	220.	A	-94.	20.
2916	NAV14	VL	2	108.00	117.95	.030	12.0		115.0	60.0	60.0	95.0	10.	220.	A	-94.	20.
2917	NAV11C	VL	2	108.00	117.95	.032	12.0	T	200.0	60.0	60.0	90.0	30.	220.	A	-99.	20.
2918	NAV111	VL	2	108.00	117.95	.032	12.0	T	200.0	60.0	60.0	90.0	30.	220.	A	-99.	20.
2919	NAV112	VL	2	108.00	117.95	.032	12.0	T	200.0	60.0	60.0	90.0	30.	220.	A	-99.	20.
2920	NAV114	VL	2	108.00	117.95	.032	12.0	T	200.0	60.0	60.0	90.0	30.	220.	A	-99.	20.
3701	1005A	VL	2	108.00	117.95	.028	20.0	T	160.0	60.0	74.0	90.0	1.	270.	B	-100.	20.
3702	1005B	VL	2	108.00	117.95	.028	20.0	T	160.0	60.0	74.0	90.0	1.	270.	B	-100.	20.
3703	1006A	VL	2	108.00	117.95	.028	20.0	T	160.0	60.0	74.0	90.0	1.	270.	B	-100.	20.
3704	1006B	VL	2	108.00	117.95	.028	20.0	T	160.0	60.0	74.0	90.0	1.	270.	B	-100.	20.
100	R319A	VL	3	108.00	117.90	.036	20.8	T	136.0	60.0	72.0	110.0	1.	306.	B	-75.	20.
101	R319G1	VL	3	108.00	117.90	.036	20.8	T	136.0	60.0	72.0	110.0	1.	306.	B	-75.	20.
104	RT308C	VL	3	108.00	117.95	.033	16.0		240.0	60.0	85.0	110.0	40.	150.	B	-97.	20.
106	RT317G	VL	3	108.00	117.95	.036	20.8	T	136.0	60.0	72.0	110.0	1.	304.	B	-81.	20.
107	RT317G1	VL	3	108.00	117.95	.036	20.8	T	136.0	60.0	72.0	110.0	1.	304.	B	-81.	20.
110	RT508A	VL	3	108.00	117.90	.033	16.0		230.0	77.0	98.0	125.0	40.	190.	B	-101.	20.
111	RT513A	VL	3	108.00	117.90	.030	32.0		80.0	60.0	83.0	120.0	1.	340.	B	-87.	20.
112	RT514A	VL	3	108.00	117.90	.027	20.8		135.0	60.0	70.0	110.0	1.	300.	B	-97.	20.
113	RT514B	VL	3	108.00	117.90	.027	20.8		135.0	60.0	70.0	110.0	1.	300.	B	-97.	20.
114	RT516A	VL	3	108.00	117.90	.030	20.8		84.0	60.0	72.0	117.0	1.	350.	B	-97.	20.
115	RT517B	VL	3	108.00	117.90	.030	20.8		84.0	60.0	72.0	117.0	1.	350.	B	-97.	20.
116	RT520A	VL	3	108.00	117.90	.033	16.0	T	164.0	77.0	84.0	111.0	40.	190.	B	-101.	20.
117	RT520E	VL	3	108.00	117.95	.033	16.0	T	164.0	77.0	64.0	111.0	40.	190.	B	-101.	20.
500	MN85	VL	3	108.00	117.90	.040	50.2		110.0	60.0	96.0	130.0	1.	490.	B	-97.	20.
501	RA21A	VL	3	108.00	117.95	.038	44.2	T	220.0	100.0	140.0	140.0	1.	290.	B	-97.	20.
502	RA22B	VL	3	108.00	117.95	.038	17.0	T	220.0	77.0	86.0	110.0	40.	210.	B	-97.	20.
503	RIA32A	L	3	108.00	111.95	.022	48.2	A	100.0	77.0	120.0	147.0	1.	310.	B	-93.	20.
504	RVA33A	V	3	108.00	117.95	.032	48.0	A	200.0	60.0	95.0	132.0	1.	520.	B	-101.	20.
900	ILS70	L	3	108.00	111.95	.040	25.5	T	300.0	80.0	100.0	125.0	1.	210.	A	-96.	20.
901	VIR30A	VL	3	108.00	117.95	.037	22.5	T	225.0	60.0	75.0	110.0	1.	290.	B	-97.	20.
902	VIR30B	VL	3	108.00	117.95	.037	22.5	T	275.0	60.0	75.0	110.0	1.	290.	B	-97.	20.
903	SIR3	VL	3	108.00	117.90	.040	21.3		100.0	60.0	75.0	110.0	1.	300.	B	-97.	20.
904	SIR6	VL	3	108.00	117.95	.038	22.0	T	280.0	80.0	120.0	135.0	40.	190.	B	-97.	20.
905	SIR7	VL	3	108.00	117.95	.048	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	20.
906	SIR7A	VL	3	108.00	117.95	.048	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	20.
907	SIR8	VL	3	108.00	117.95	.048	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	20.
908	SIR8A	VL	3	108.00	117.95	.048	22.0	T	370.0	60.0	90.0	110.0	10.	220.	B	-97.	20.
909	SIRV2B	VL	3	108.00	117.95	.048	30.1	A	260.0	60.0	83.0	117.0	1.	350.	A	-97.	20.
910	SLX2	VL	3	108.00	117.95	.031	12.0	T	175.0	80.0	82.0	110.0	40.	190.	B	-101.	20.
911	SLX2B	VL	3	108.00	117.95	.031	12.0	T	175.0	80.0	82.0	110.0	40.	190.	B	-101.	20.
912	SLX2C	VL	3	108.00	117.95	.031	12.0	T	175.0	80.0	82.0	110.0	40.	190.	B	-101.	20.
914	SLX4	VL	3	108.00	117.95	.038	22.5		280.0	80.0	130.0	130.0	40.	190.	B	-97.	20.
1300	NR4020A	VL	3	108.00	117.95	.038	20.0		200.0	80.0	90.0	110.0	50.	180.	B	-101.	20.
1301	NR4028A	VL	3	108.00	117.95	.038	20.0		200.0	80.0	90.0	110.0	50.	180.	B	-101.	20.

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**** AVBASE RECEIVERS ****

KEY NO	NOMENCLATURE	CLASS	LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRQ MHZ.	HI SPR FRQ MHZ.	LO POS	SENS DBM.	S/I DB
1302	200	VL J	108.00	117.95	.028	21.4		140.0	80.0	90.0	110.0	50.	180.	B	-101.	20.
2500	KN50A	VL J	108.00	117.90	.034	35.6		80.0	80.0	100.0	125.0	.1.	240.	B	-101.	20.
2512	KR40	VL J	108.00	117.90	.034	32.6		90.0	80.0	104.0	130.0	.1.	230.	B	-101.	20.
2513	KR40A	VL J	108.00	117.90	.034	32.6		90.0	80.0	104.0	130.0	.1.	230.	B	-101.	20.
2514	KR40B	VL J	108.00	117.90	.034	32.6		90.0	80.0	104.0	130.0	.1.	230.	B	-101.	20.
2906	MK5	VL J	108.00	117.90	.036	26.0		92.0	60.0	80.0	110.0	.1.	300.	B	-103.	20.
2907	MK6	VL J	108.00	117.90	.036	26.4		92.0	60.0	80.0	110.0	1.	300.	B	-101.	20.
2909	MK10	VL J	108.00	117.90	.034	32.0		90.0	60.0	80.0	120.0	1.	300.	B	-103.	20.
3300	AVN210	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3301	AVN211	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3302	AVN212	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3303	AVN214	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3304	AVN215	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3305	AVN220	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3306	AVN220A	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3307	AVN221	VL J	108.00	117.95	.040	32.0	T	160.0	60.0	90.0	114.0	.1.	270.	B	-103.	20.
3700	8G6A	VL J	108.00	117.95	.036	43.0	T	160.0	80.0	150.0	140.0	.1.	320.	B	-97.	20.
200	R319A	G 0	329.30	335.00	.120	30.0	T	90.0	80.0	75.0	85.0	250.	410.	B	-81.	20.
201	R319B	G 0	329.30	335.00	.120	30.0	T	90.0	80.0	75.0	85.0	250.	410.	B	-81.	20.
202	R443B	G 0	329.15	335.00	.054	29.6	T	85.0	60.0	60.0	75.0	230.	435.	B	-75.	20.
203	R543B	G 0	329.30	335.00	.040	29.7	T	60.0	60.0	40.0	90.0	140.	500.	B	-75.	20.
600	GN247A	G 0	329.15	335.00	.060	60.2	T	95.0	60.0	80.0	100.0	30.	600.	B	-79.	20.
601	GSA4A	G 0	329.30	335.00	.120	51.5	T	120.0	80.0	94.0	120.0	90.	570.	B	-81.	20.
602	GSA25B	G 0	329.30	335.00	.108	51.4	T	90.0	60.0	75.0	96.0	90.	570.	B	-87.	20.
603	RIA32A	G 0	329.30	335.00	.038	52.0	T	100.0	80.0	93.0	120.0	110.	550.	B	-81.	20.
604	RN222A	G 0	329.30	335.00	.095	60.0		60.0	60.0	62.0	100.0	60.	600.	B	-81.	20.
605	RN222BE	G 0	329.30	335.00	.095	60.0		60.0	60.0	62.0	100.0	60.	600.	B	-81.	20.
606	RNA26C	G 0	329.30	335.00	.108	49.0	A	90.0	60.0	75.0	96.0	90.	570.	B	-100.	20.
1000	ILS70	G 0	329.15	335.00	.064	25.5	T	150.0	80.0	70.0	90.0	240.	420.	B	-93.	20.
1001	VIR30	G 0	329.15	335.00	.064	61.0	T	150.0	40.0	80.0	106.0	1.	2000.	B	-87.	20.
1002	51RV1	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1003	51RV1A	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1004	51RV1C	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1005	51RV2B	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1006	51V2	G 0	329.30	335.00	.120	20.7		90.0	95.0	73.0	96.0	270.	390.	B	-81.	20.
1007	51V3	G 0	329.30	335.00	.120	21.0	T	100.0	95.0	74.0	92.0	270.	390.	B	-81.	20.
1008	51V4	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1009	51V4A	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1010	51V4B	G 0	329.30	335.00	.120	30.0	A	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1011	51V5	G 0	329.30	335.00	.120	30.0	T	90.0	80.0	76.0	86.0	250.	410.	B	-81.	20.
1400	240	G 0	329.15	335.00	.040	.0		110.0	80.0	60.0	70.0	240.	425.	B	-77.	20.
2200	PM120	G 0	329.30	335.00	.080	.5		80.0	80.0	60.0	60.0	290.	370.	A	-77.	20.
2600	KGS40D	G 0	329.30	335.00	.064	22.0	T	67.0	60.0	55.0	76.0	230.	430.	B	-81.	20.
2601	KGS40I	G 0	329.15	335.00	.035	74.0	T	70.0	60.0	84.0	108.0	.1.	730.	B	-75.	20.
2602	KI211	G 0	329.30	335.00	.120	47.0		60.0	40.0	50.0	86.0	.1.	1030.	B	-75.	20.
2603	KI211A	G 0	329.30	335.00	.120	44.0		60.0	40.0	40.0	65.0	30.	635.	B	-75.	20.
2604	KI211B	G 0	329.30	335.00	.120	44.0		60.0	40.0	40.0	65.0	30.	635.	B	-75.	20.
2605	KI211C	G 0	329.15	335.00	.120	44.0		60.0	40.0	40.0	65.0	30.	635.	B	-75.	20.

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**** AVBASE RECEIVERS ****

KEY NO	NOMENCLATURE		CLASS	LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IN REJ DB.	SP REJ DB.	LO SPR FRQ MHZ.	HI SPR FRQ MHZ.	LO PCS	SENS DBM.	S/I DB
2606	KI213	6	0	329.15	335.00	.080	23.0		60.0	40.0	40.0	65.0	230.	430.	B	-75.	20.
2607	KI214	6	0	329.15	335.00	.080	23.0		60.0	40.0	40.0	65.0	230.	430.	B	-75.	20.
2608	KN70	6	0	329.30	335.00	.095	93.0	T	60.0	60.0	70.0	90.0	190.	520.	B	-81.	20.
2609	KN73	6	0	329.15	335.00	.035	74.0	T	70.0	60.0	84.0	100.0	1.	730.	B	-75.	20.
2610	KNR615	6	0	329.15	335.00	.034	74.0	T	70.0	60.0	80.0	90.0	30.	640.	B	-75.	20.
2611	KNR630	6	0	329.15	335.00	.034	74.0	T	70.0	60.0	80.0	90.0	30.	640.	B	-75.	20.
2612	KNR631	6	0	329.15	335.00	.034	74.0	T	70.0	60.0	80.0	90.0	30.	640.	B	-75.	20.
2613	KNR665	6	0	329.15	335.00	.034	74.0	T	70.0	60.0	80.0	90.0	30.	640.	B	-75.	20.
3000	UGR1A	6	0	329.30	335.00	.100	25.0	T	60.0	60.0	80.0	100.0	1.	630.	B	-81.	20.
3001	UGR2	6	0	329.30	335.00	.100	28.0	T	80.0	60.0	60.0	84.0	180.	480.	B	-81.	20.
3002	UGR2A	6	0	329.15	335.00	.100	27.0	T	80.0	60.0	45.0	60.0	230.	435.	B	-81.	20.
3003	UGR3	6	0	329.15	335.00	.084	27.0		80.0	60.0	45.0	60.0	230.	435.	B	-81.	20.
3400	AVN210	6	0	329.30	335.00	.044	63.0	T	70.0	40.0	50.0	76.0	1.	930.	B	-81.	20.
3401	AVN212	6	0	329.30	335.00	.044	63.0	T	70.0	40.0	50.0	76.0	1.	930.	B	-81.	20.
3402	AVN214	6	0	329.30	335.00	.044	63.0	T	70.0	40.0	50.0	76.0	1.	930.	B	-81.	20.
3403	AVN220	6	0	329.15	335.00	.100	62.8	T	190.0	60.0	80.0	100.0	30.	600.	B	-81.	20.
3404	AVN22CA	6	0	329.15	335.00	.100	62.8	T	190.0	60.0	80.0	100.0	30.	600.	B	-81.	20.
3800	806A	6	0	329.30	335.00	.100	60.0	T	87.0	110.0	134.0	124.0	230.	435.	B	-97.	20.
3801	1000B	6	0	329.30	335.00	.030	22.0	T	60.0	100.0	74.0	90.0	270.	400.	B	-81.	20.
3802	1000A	6	0	329.30	335.00	.030	22.0	T	60.0	100.0	74.0	90.0	270.	400.	B	-81.	20.
240	RT105A	ATC	0	1030.10	30.00	9.400	60.0	T	83.0	60.0	62.0	80.0	780.	1280.	A	-74.	10.
241	RT105B	ATC	0	1030.00	1030.00	6.600	60.0	T	97.0	40.0	62.0	80.0	780.	1280.	A	-74.	10.
242	RT106A	ATC	0	1030.00	1030.00	6.000	60.0	T	55.0	55.0	65.0	84.0	730.	1330.	A	-74.	10.
243	RT359A	ATC	0	1030.00	1030.00	5.000	60.0	T	60.0	80.0	75.0	85.0	950.	1250.	B	-72.	10.
244	RT459A	ATC	0	1030.00	1030.00	5.000	60.0	T	60.0	80.0	75.0	85.0	950.	1250.	B	-72.	10.
245	RT506A	ATC	0	1030.00	1030.00	3.600	60.0	T	54.0	57.0	65.0	84.0	730.	1330.	A	-74.	10.
246	RT859A	ATC	0	1030.00	1030.00	5.000	60.0	T	60.0	80.0	75.0	85.0	950.	1250.	B	-72.	10.
640	TPR610	ATC	0	1030.00	1030.00	6.000	60.0	T	80.0	60.0	60.0	80.0	800.	1250.	A	-72.	10.
641	TPR640C	ATC	0	1030.00	1030.00	6.000	60.0		60.0	40.0	64.0	83.0	780.	1280.	A	-72.	10.
642	TRA61A	ATC	0	1030.00	1030.00	6.000	60.0	A	80.0	60.0	60.0	80.0	800.	1250.	A	-74.	10.
643	TRA61AL	ATC	0	1030.00	1030.00	6.000	60.0	A	80.0	60.0	60.0	80.0	800.	1250.	A	-74.	10.
644	TRA61C	ATC	0	1030.00	1030.00	6.000	60.0	A	80.0	60.0	60.0	80.0	800.	1250.	A	-74.	10.
645	TRA63A	ATC	0	1030.00	1030.00	6.000	60.0	A	60.0	40.0	62.0	80.0	780.	1280.	A	-74.	10.
1040	TDR90	ATC	0	1030.00	1030.00	6.000	60.0	T	80.0	60.0	60.0	80.0	800.	1250.	A	-74.	10.
1042	621A2	ATC	0	1030.00	1030.00	6.000	60.0		80.0	60.0	60.0	80.0	800.	1250.	A	-72.	10.
1044	621A2A	ATC	0	1030.00	1030.00	6.000	60.0		80.0	60.0	60.0	80.0	800.	1250.	A	-72.	10.
1046	621A3	ATC	0	1030.00	1030.00	6.000	60.0	A	100.0	60.0	60.0	80.0	800.	1300.	A	-72.	10.
1048	621A6	ATC	0	1030.00	1030.00	6.000	60.0	T	80.0	60.0	60.0	80.0	800.	1250.	A	-76.	10.
1840	RT667	ATC	0	1030.00	1030.00	5.000	55.0	T	60.0	80.0	80.0	80.0	930.	1130.	C	-74.	10.
1841	RT667A	ATC	0	1030.00	1030.00	5.000	55.0	T	60.0	80.0	80.0	80.0	930.	1130.	C	-74.	10.
1842	RT777	ATC	0	1030.00	1030.00	5.000	55.0	T	60.0	80.0	80.0	80.0	930.	1130.	C	-74.	10.
2240	8500	ATC	0	1030.00	1030.00	6.000	60.0		100.0	60.0	60.0	70.0	800.	1250.	A	-72.	10.
2241	84096	ATC	0	1030.00	1030.00	6.000	60.0	T	100.0	60.0	60.0	70.0	800.	1250.	A	-72.	10.
2242	85000	ATC	0	1030.00	1030.00	6.000	60.0	T	100.0	60.0	60.0	70.0	800.	1250.	A	-72.	10.
2640	KT75	ATC	0	1030.00	1030.00	6.000	60.0	T	60.0	60.0	64.0	83.0	780.	1280.	A	-72.	10.
2641	KT75R	ATC	0	1030.00	1030.00	6.000	60.0	T	60.0	60.0	64.0	83.0	780.	1280.	A	-72.	10.
2642	KT76	ATC	0	1030.00	1030.00	6.000	60.0	T	60.0	60.0	64.0	83.0	780.	1280.	A	-72.	10.
2643	KT78	ATC	0	1030.00	1030.00	6.000	60.0	T	60.0	60.0	64.0	83.0	780.	1280.	A	-72.	10.

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**** AVBASE RECEIVERS ****

KEY NO	NOMENCLATURE		CLASS	LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSQ IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRQ MHZ.	HI SPR FRQ MHZ.	LO POS	SENS DBM.	S/I DB
2644	KXP750	ATC	0	1030.00	1030.00	6.000	60.0	T	60.0	40.0	64.0	83.0	780.	1280.	A	-72.	10.
2645	KXP750A	ATC	0	1030.00	1030.00	6.000	60.0	T	60.0	40.0	64.0	83.0	780.	1280.	A	-72.	10.
2646	KXP755	ATC	0	1030.00	1030.00	10.000	60.0	T	80.0	40.0	60.0	80.0	760.	1300.	B	-75.	10.
3040	AT5A	ATC	0	1030.00	1030.00	9.000	60.0		80.0	40.0	64.0	84.0	780.	1280.	A	-72.	10.
3041	AT6A	ATC	0	1030.00	1030.00	9.000	60.0	T	80.0	40.0	64.0	84.0	780.	1280.	A	-72.	10.
3042	AT50	ATC	0	1030.00	1030.00	7.000	60.0	T	60.0	80.0	80.0	90.0	1170.	1960.	A	-72.	10.
3043	UAT1	ATC	0	1030.00	1030.00	7.000	60.0	T	70.0	40.0	60.0	80.0	800.	1250.	A	-74.	10.
3440	AVQ60	ATC	0	1030.00	1030.00	7.000	60.0	A	90.0	40.0	64.0	83.0	780.	1280.	A	-72.	10.
3441	AVQ65	ATC	0	1030.00	1030.00	7.000	60.0	A	100.0	60.0	77.0	100.0	730.	1330.	A	-72.	10.
3442	AVQ75	ATC	0	1030.00	1030.00	6.900	60.0	T	85.0	70.0	94.0	80.0	1000.	1100.	A	-72.	10.
3840	914	ATC	0	1030.00	1030.00	5.500	60.0	A	55.0	80.0	80.0	90.0	900.	1200.	A	-74.	10.
3841	1014A	ATC	0	1030.00	1030.00	5.500	60.0	T	60.0	130.0	75.0	65.0	930.	1130.	A	-74.	10.
480	RDR1D	WR	0	9375.00	9375.00	1.200	60.0	T	140.0	900.0	.0	60.0	6560.	15000.	A	-102.	10.
481	RDR1E	WR	0	9375.00	9375.00	1.200	60.0	A	140.0	900.0	.0	60.0	6560.	15000.	A	-104.	10.
482	RDR1F	WR	0	9375.00	9375.00	.800	60.0	A	140.0	900.0	.0	60.0	6560.	15000.	A	-104.	10.
483	RDR110	WR	0	15500.00	15500.00	1.500	30.0	T	140.0	900.0	.0	60.0	9440.	20000.	A	-100.	10.
484	RDR140	WR	0	9345.00	9345.00	.450	60.0	T	60.0	200.0	.0	60.0	6560.	15000.	A	-106.	10.
485	RDR1200	WR	0	9345.00	9345.00	.450	60.0	T	40.0	200.0	.0	60.0	6560.	15000.	A	-106.	10.
1080	WP103	WR	0	9375.00	9375.00	1.000	30.0	T	100.0	600.0	.0	60.0	6560.	10000.	A	-104.	10.
1081	WP103G	WR	0	9375.00	9375.00	1.000	30.0	T	100.0	600.0	.0	60.0	6560.	10000.	A	-104.	10.
1082	WXR80	WR	0	9345.00	9345.00	.450	63.0	T	100.0	900.0	.0	60.0	6560.	15000.	B	-110.	10.
2480	KWX40	WR	0	9375.00	9375.00	.450	30.0	T	60.0	200.0	20.0	60.0	6560.	15000.	C	-107.	10.
3480	AVQ10	WR	0	5400.00	5400.00	1.100	60.0	T	120.0	900.0	15.0	60.0	3700.	15000.	A	-102.	10.
3481	AVQ20	WR	0	9375.00	9375.00	1.700	30.0	T	80.0	900.0	.0	75.0	6560.	15000.	A	-105.	10.
3482	AVQ20A	WR	0	9375.00	9375.00	1.700	30.0	T	80.0	900.0	.0	75.0	6560.	14000.	A	-105.	10.
3483	AVQ21	WR	0	9345.00	9345.00	.350	60.0	T	80.0	80.0	35.0	60.0	9000.	9600.	B	-110.	10.
3484	AVQ30C	WR	0	5400.00	5400.00	.500	30.0	A	40.0	80.0	.0	60.0	4300.	8200.	B	-105.	10.
3485	AVQ30X	WR	0	9345.00	9345.00	.700	30.0	A	40.0	900.0	.0	60.0	6560.	15000.	B	-105.	10.
3486	AVQ45	WR	0	9375.00	9375.00	3.200	30.0		140.0	900.0	.0	60.0	6560.	15000.	A	-102.	10.
3487	AVQ46	WR	0	9375.00	9375.00	3.200	30.0	T	140.0	900.0	.0	60.0	6560.	14000.	A	-102.	10.
3488	AVQ47	WR	0	9375.00	9375.00	3.200	30.0	T	140.0	900.0	.0	60.0	6560.	15000.	A	-102.	10.
3489	AVQ50	WR	0	9375.00	9375.00	1.100	60.0		120.0	900.0	.0	60.0	6560.	15000.	A	-102.	10.
3490	AVQ55	WR	0	9375.00	9375.00	1.600	30.0	A	80.0	900.0	.0	60.0	6560.	15000.	A	-102.	10.
1120	DME40	DME	0	962.00	1213.00	.960	63.0	T	120.0	80.0	70.0	80.0	800.	1060.	C	-82.	10.
1121	860E3	DME	0	962.00	1213.00	.500	63.0	A	100.0	120.0	60.0	60.0	900.	1250.	C	-93.	10.
2720	KDM700	DME	0	978.00	1213.00	.140	63.0	T	60.0	60.0	50.0	70.0	850.	1340.	C	-80.	10.
2721	KDM700A	DME	0	978.00	1213.00	.140	63.0	T	60.0	60.0	50.0	70.0	850.	1340.	C	-80.	10.
2722	KDM705	DME	0	978.00	1213.00	.900	63.0	T	70.0	80.0	60.0	70.0	820.	1375.	C	-80.	10.
2723	KDM705A	DME	0	978.00	1213.00	.900	63.0	T	70.0	80.0	60.0	70.0	820.	1375.	C	-80.	10.
2724	KDM7000	DME	0	978.00	1213.00	.350	63.0	A	80.0	80.0	80.0	80.0	800.	1350.	C	-90.	10.
2725	KN60	DME	0	978.00	1213.00	.350	63.0		60.0	90.0	35.0	80.0	.1	3700.	C	-78.	10.
2726	KN60B	DME	0	978.00	1213.00	.350	63.0		60.0	90.0	35.0	80.0	.1	3700.	C	-78.	10.
2727	KN60C	DME	0	978.00	1213.00	.350	63.0		60.0	90.0	35.0	80.0	.1	3700.	C	-78.	10.
2728	KN65	DME	0	978.00	1213.00	.300	11.4	T	80.0	80.0	60.0	70.0	800.	1370.	C	-80.	10.
3120	DME70	DME	0	978.00	1213.00	1.000	63.0		80.0	90.0	40.0	76.0	280.	1900.	C	-73.	10.
3121	DME140	DME	0	978.00	1213.00	.400	63.0		100.0	40.0	60.0	40.0	.1	2200.	C	-82.	10.
3122	UB12A	DME	0	978.00	1213.00	.170	63.0	T	130.0	80.0	60.0	85.0	420.	1540.	C	-76.	10.
3123	UB12AR	DME	0	978.00	1213.00	.170	63.0	T	130.0	80.0	60.0	85.0	420.	1540.	C	-76.	10.

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**** AVBASE RECEIVERS ****

KEY NO	NOMENCLATURE	CLASS	LO FRQ MHZ.	HI FRQ MHZ.	IF BW MHZ.	IF MHZ.	TSO IND	IF SF DB/DEC	RF SF DB/DEC	IM REJ DB.	SP REJ DB.	LO SPR FRQ MHZ.	HI SPR FRQ MHZ.	LO POS	SENS DBM.	S/I DB
3124	UD13	DME	0	978.00	1213.00	.500	63.0		90.0	90.0	90.0	70.0	280.	1900.	C	-73.	10.
3125	UD19	DME	0	978.00	1213.00	.500	63.0		90.0	90.0	90.0	70.0	280.	1900.	C	-73.	10.
3520	AV070	DME	0	978.00	1213.00	.300	63.0	A	100.0	60.0	70.0	90.0	730.	1990.	C	-85.	10.
3521	AV075	DME	0	978.00	1213.00	.350	11.3	T	80.0	60.0	60.0	60.0	850.	1300.	C	-90.	10.
3522	AV085	DME	0	978.00	1213.00	.360	11.3	A	120.0	60.0	60.0	60.0	850.	1300.	C	-90.	10.
760	ALA51	ALT	0	4300.00	4300.00	.900	.2	A	20.0	80.0	20.0	70.0	4100.	4500.	B	-73.	20.
1160	AL101	ALT	0	4300.00	4300.00	.100	100.0	A	120.0	80.0	.0	.0	4100.	4500.	B	-93.	20.
1161	AL750	ALT	0	4300.00	4300.00	.080	80.0	A	60.0	60.0	.0	.0	4200.	4900.	B	-100.	20.

CONTENTS OF AVFILE

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NO. TX TYPES =    4

NO. RX TYPES =   10

COSITE PATH LOSS CUMULATIVE DISTRIBUTION PARAMETERS:

        DISTRIBUTION TYPE=    1 (0=NONE,1=NORMAL,2=UNIFORM,3=USER-SPECIFIED)

        MEDIAN ERROR =     .00 DB.

        STANDARD ERROR =    6.00 DB.

        UPPER DECILE VALUE =    9.00 DB.

        USER-SPECIFIED DISTRIBUTION POINTS:

              .00     .00     .00     .00     .00     .00     .00 (PROBABILITY LEVELS 0.0 TO 0.3)
              .00     .00     .00     .00     .00     .00     .00 (PROBABILITY LEVELS 0.35 TO 0.65)
              .00     .00     .00     .00     .00     .00     .00 (PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
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TRANSMITTER FUNCTIONAL CLASSES:

NOMENCLATURE= VHF COMM            LOWER OPER. FREQ.=  118.00 MHZ.           UPPER OPER. FREQ.=  135.90 MHZ.
BW OF FIRST BREAKPOINTS=       .01 MHZ.          BW OF SECOND BREAKPOINTS=       .00 MHZ.
FIRST EMISSION SLOPE FALLOFF=   80.00 DB/DEC            SECOND EMISSION SLOPE FALLOFF=   40.00 DB/DEC.
OUTPUT POWER=   40.00 DBW            MOD. TYPE=A3
PULSE COMPRESSION INDICATOR=              PULSEWIDTH=      .00 USEC.           PULSE RISE/FALL TIME=      .00 USEC.
LOWER FILTER FREQ.=      .00 MHZ.        UPPER FILTER FREQ.=      .00 MHZ.
NO. OF HARMONICS TO BE CONSIDERED=    3           SUPPRESSION LEVELS=   66.1   89.0     .0      .0      .0      .0      .0      .0
AVFILE NUMERIC CODE IDENTIFIER=     1          PULSE REPETITION FREQUENCY=      .00 KHZ.

DISTRIBUTIONS:

      DISTRIBUTION TYPE      1            USED FOR PT                DISTRIBUTION             MEDIAN ERROR=      .00 DB.
STANDARD ERROR=    3.00 DB.          UPPER DECILE VALUE=     4.90 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

      DISTRIBUTION TYPE      1            USED FOR TOFR              DISTRIBUTION             MEDIAN ERROR=      .00 DB.
STANDARD ERROR=      .00 DB.          UPPER DECILE VALUE=      .00 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

      (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= ATC.XPONDER          LOWER OPER. FREQ.= 1090.00 MHZ.           UPPER OPER. FREQ.= 1090.00 MHZ.
BW OF FIRST BREAKPOINTS=      1.91 MHZ.          BW OF SECOND BREAKPOINTS=      8.50 MHZ.
FIRST EMISSION SLOPE FALLOFF=   20.00 DB/DEC            SECOND EMISSION SLOPE FALLOFF=   40.00 DB/DEC.
OUTPUT POWER=   55.00 DBW            MOD. TYPE=PO
PULSE COMPRESSION INDICATOR=              PULSEWIDTH=      .42 USEC.           PULSE RISE/FALL TIME=      .00 USEC.
LOWER FILTER FREQ.=      .00 MHZ.        UPPER FILTER FREQ.=      .00 MHZ.
NO. OF HARMONICS TO BE CONSIDERED=    3           SUPPRESSION LEVELS=   73.1   90.1     .0      .0      .0      .0      .0      .0 DB.
AVFILE NUMERIC CODE IDENTIFIER=     2          PULSE REPETITION FREQUENCY=      .00 KHZ.

DISTRIBUTIONS:

      DISTRIBUTION TYPE      1            USED FOR PT                DISTRIBUTION             MEDIAN ERROR=      .00 DB.
STANDARD ERROR=    2.30 DB.          UPPER DECILE VALUE=     3.80 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                    .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

      DISTRIBUTION TYPE      1            USED FOR TOFR              DISTRIBUTION             MEDIAN ERROR=      .00 DB.
STANDARD ERROR=    9.00 DB.          UPPER DECILE VALUE=    15.00 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
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          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

     (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= WEATHERRADAR          LOWER OPER. FREQ.= 9215.00 MHZ.          UPPER OPER. FREQ.= 9915.00 MHZ.
BW OF FIRST BREAKPOINTS=      .29 MHZ.        BW OF SECOND BREAKPOINTS=      3.39 MHZ.
FIRST EMISSION SLOPE FALLOFF=   20.00 DB/DEC            SECOND EMISSION SLOPE FALLOFF=   40.00 DB/DEC.
OUTPUT POWER=   73.06 DBM            MOD. TYPE=PO
PULSE COMPRESSION INDICATOR=              PULSEWIDTH=    3.13 USEC.            PULSE RISE/FALL TIME=      .19 USEC.
LOWER FILTER FREQ.=   6985.26 MHZ.          UPPER FILTER FREQ.= 15230.00 MHZ.
NO. OF HARMONICS TO BE CONSIDERED=     2           SUPPRESSION LEVELS=   61.0      .0      .0      .0      .0      .0      .0 DB.
AVFILE NUMERIC CODE IDENTIFIER.     3           PULSE REPETITION FREQUENCY=      .00 KHZ.

DISTRIBUTIONS:

       DISTRIBUTION TYPE     1          USED FOR PT              DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    9.00 DB.           UPPER DECILE VALUE=    6.50 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

       DISTRIBUTION TYPE     1          USED FOR TOFR            DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    6.00 DB.           UPPER DECILE VALUE=    9.90 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

     (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= DME                   LOWER OPER. FREQ.= 1025.00 MHZ.          UPPER OPER. FREQ.= 1150.00 MHZ.
BW OF FIRST BREAKPOINTS=      .33 MHZ.        BW OF SECOND BREAKPOINTS=      7.37 MHZ.
FIRST EMISSION SLOPE FALLOFF=   60.00 DB/DEC            SECOND EMISSION SLOPE FALLOFF=   20.00 DB/DEC.
OUTPUT POWER=   51.00 DBM            MOD. TYPE=PC
PULSE COMPRESSION INDICATOR=              PULSEWIDTH=    3.98 USEC.            PULSE RISE/FALL TIME=     4.29 USEC.
LOWER FILTER FREQ.=      .00 MHZ.          UPPER FILTER FREQ.=      .00 MHZ.
NO. OF HARMONICS TO BE CONSIDERED=     3           SUPPRESSION LEVELS=   50.7    50.9      .0      .0      .0      .0      .0 DB.
AVFILE NUMERIC CODE IDENTIFIER.     4           PULSE REPETITION FREQUENCY=      .00 KHZ.

DISTRIBUTIONS:

       DISTRIBUTION TYPE     1          USED FOR PT              DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    6.30 DB.           UPPER DECILE VALUE=   10.00 DB.
          USER-SPECIFIED DISTRIBUTION POINTS=
          .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
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                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

      DISTRIBUTION TYPE    1        USED FOR TOFR          DISTRIBUTION         MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    2.00 DB.        UPPER DECILE VALUE=    3.30 DB.
          USER-SPECIFIED DISTRIBUTION PRINTS=
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

      (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
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RECEIVER FUNCTIONAL CLASSES:

NOMENCLATURE= VL ONE              LOWER OPER. FREQ.=  108.10 MHZ.          UPPER OPER. FREQ.=  117.90 MHZ.
IF BW=    .03 MHZ.         RX. IF=   26.00 MHZ.         IF SELECTIVITY FALLOFF=  113.00 DB/DEC
RF SELECTIVITY FALLOFF=   79.20 DB/DEC           IMAGE REJECTION=   80.30 DB.          SPURIOUS REJECTION=   70.00 DB.
LOWER SPURIOUS FREQ. LIMIT=   33.70 MHZ.           UPPER SPURIOUS FREQ. LIMIT=  213.33 MHZ.           LOCAL OSCILLATOR POSITION= C
SENSITIVITY= -101.00 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   20.00 DB           AVFILE NUMERIC CODE IDENTIFIER=   SC

DISTRIBUTIONS:

       DISTRIBUTION TYPE     1            USED FOR RS              DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    2.10 DB.            UPPER DECILE VALUE=     3.50 DB.
         USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

       DISTRIBUTION TYPE     1            USED FOR ROFR            DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    9.40 DB.            UPPER DECILE VALUE=    15.00 DB.
         USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

       (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= VL TWO              LOWER OPER. FREQ.=  108.10 MHZ.          UPPER OPER. FREQ.=  117.90 MHZ.
IF BW=    .03 MHZ.         RX. IF=   26.00 MHZ.         IF SELECTIVITY FALLOFF=  140.00 DB/DEC
RF SELECTIVITY FALLOFF=   66.90 DB/DEC           IMAGE REJECTION=   72.30 DB.          SPURIOUS REJECTION=   97.30 DB.
LOWER SPURIOUS FREQ. LIMIT=   21.00 MHZ.           UPPER SPURIOUS FREQ. LIMIT=  243.91 MHZ.           LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -98.60 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   20.00 DB           AVFILE NUMERIC CODE IDENTIFIER=   S1

DISTRIBUTIONS:

       DISTRIBUTION TYPE     1            USED FOR RS              DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    4.20 DB.            UPPER DECILE VALUE=     6.90 DB.
         USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

       DISTRIBUTION TYPE     1            USED FOR ROFR            DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    4.40 DB.            UPPER DECILE VALUE=     7.20 DB.
         USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

       (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
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NOMENCLATURE= VL THREE            LOWER OPER. FREQ.=  108.10 MHZ.          UPPER OPER. FREQ.=  117.95 MHZ.
IF BW=    .09 MHZ.        RX. IF=   26.00 MHZ.         IF SELECTIVITY FALLOFF=  179.00 DB/DEC
RF SELECTIVITY FALLOFF=   67.90 DB/DEC           IMAGE REJECTION=   89.00 DB.            SPURIOUS REJECTION=  116.00 DB.
LOWER SPURIOUS FREQ. LIMIT=   15.55 MHZ.          UPPER SPURIOUS FREQ. LIMIT=  266.12 MHZ.            LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -97.30 DBM.            SIGNAL TO INTERFERENCE THRESHOLD=   20.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   52

DISTRIBUTIONS:

         DISTRIBUTION TYPE     1           USED FOR RS              DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    7.00 DB.           UPPER DECILE VALUE=    12.00 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

         DISTRIBUTION TYPE     1           USED FOR RDFR            DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    6.90 DB.           UPPER DECILE VALUE=    15.00 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

         (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= COMM ONE            LOWER OPER. FREQ.=  118.00 MHZ.          UPPER OPER. FREQ.=  135.98 MHZ.
IF BW=    .03 MHZ.        RX. IF=   20.00 MHZ.         IF SELECTIVITY FALLOFF=  138.00 DB/DEC
RF SELECTIVITY FALLOFF=   90.20 DB/DEC           IMAGE REJECTION=   19.00 DB.            SPURIOUS REJECTION=   67.00 DB.
LOWER SPURIOUS FREQ. LIMIT=   16.76 MHZ.          UPPER SPURIOUS FREQ. LIMIT=  232.00 MHZ.            LOCAL OSCILLATOR POSITION= C
SENSITIVITY= -101.00 DBM.            SIGNAL TO INTERFERENCE THRESHOLD=   10.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   53

DISTRIBUTIONS:

         DISTRIBUTION TYPE     1           USED FOR RS              DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    2.00 DB.           UPPER DECILE VALUE=     3.30 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

         DISTRIBUTION TYPE     1           USED FOR RDFR            DISTRIBUTION            MEDIAN ERROR=     .00 DB.
STANDARD ERROR=   10.00 DB.           UPPER DECILE VALUE=    17.00 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                        .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

         (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
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NOMENCLATURE= COMM TWO             LOWER OPER. FREQ.=  118.00 MHZ.          UPPER OPER. FREQ.=  135.98 MHZ.
IF BW=    .03 MHZ.          RF. IF=   20.00 MHZ.          IF SELECTIVITY FALLOFF=  140.00 DB/DEC
RF SELECTIVITY FALLOFF=   66.10 DB/DEC            IMAGE REJECTION=   70.60 DB.          SPURIOUS REJECTION=   96.00 DB.
LOWER SPURIOUS FREQ. LIMIT=   93.82 MHZ.          UPPER SPURIOUS FREQ. LIMIT=  216.10 MHZ.          LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -98.70 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   10.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   54

DISTRIBUTIONS:

        DISTRIBUTION TYPE     1          USED FOR AS               DISTRIBUTION             MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    3.00 DB.         UPPER DECILE VALUE=     6.30 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        DISTRIBUTION TYPE     1          USED FOR ROFR             DISTRIBUTION             MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    4.90 DB.         UPPER DECILE VALUE=     8.10 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= COMM THREE           LOWER OPER. FREQ.=  118.00 MHZ.          UPPER OPER. FREQ.=  135.98 MHZ.
IF BW=    .03 MHZ.          RF. IF=   20.00 MHZ.          IF SELECTIVITY FALLOFF=  100.00 DB/DEC
RF SELECTIVITY FALLOFF=   67.30 DB/DEC            IMAGE REJECTION=   81.80 DB.          SPURIOUS REJECTION=  116.00 DB.
LOWER SPURIOUS FREQ. LIMIT=   20.02 MHZ.          UPPER SPURIOUS FREQ. LIMIT=  371.79 MHZ.          LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -98.00 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   10.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   55

DISTRIBUTIONS:

        DISTRIBUTION TYPE     1          USED FOR AS               DISTRIBUTION             MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    6.70 DB.         UPPER DECILE VALUE=    11.00 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        DISTRIBUTION TYPE     1          USED FOR ROFR             DISTRIBUTION             MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    6.50 DB.         UPPER DECILE VALUE=    11.00 DB.
            USER-SPECIFIED DISTRIBUTION POINTS=
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                       .00      .00      .00      .00      .00      .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
```

(Page 8 of 9)

```
NOMENCLATURE= GLIDESLOPE          LOWER OPER. FREQ.= 329.30 MHZ.          UPPER OPER. FREQ.= 335.00 MHZ.
IF BW=    .09 MHZ.          RX. IF=   95.00 MHZ.          IF SELECTIVITY FALLOFF=   85.20 DB/DEC
RF SELECTIVITY FALLOFF=   65.90 DB/DEC          IMAGE REJECTION=   69.00 DB.          SPURIOUS REJECTION=   87.50 DB.
LOWER SPURIOUS FREQ. LIMIT=  142.10 MHZ.          UPPER SPURIOUS FREQ. LIMIT=  869.00 MHZ.          LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -88.30 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   20.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   56

DISTRIBUTIONS:

        DISTRIBUTION TYPE     1          USED FOR RS               DISTRIBUTION          MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    5.10 DB.          UPPER DECILE VALUE=    8.50 DB.
          USER-SPECIFIED DISTRIBUTION POINTS.
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        DISTRIBUTION TYPE     1          USED FOR ROFR             DISTRIBUTION          MEDIAN ERROR=     .00 DB.
STANDARD ERROR=   15.00 DB.          UPPER DECILE VALUE=   25.00 DB.
          USER-SPECIFIED DISTRIBUTION POINTS.
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= ATC XPONDER          LOWER OPER. FREQ.= 1030.00 MHZ.          UPPER OPER. FREQ.= 1030.00 MHZ.
IF BW=   6.23 MHZ.          RX. IF=   60.00 MHZ.          IF SELECTIVITY FALLOFF=   73.20 DB/DEC
RF SELECTIVITY FALLOFF=   65.00 DB/DEC          IMAGE REJECTION=   66.70 DB.          SPURIOUS REJECTION=   81.90 DB.
LOWER SPURIOUS FREQ. LIMIT=  828.30 MHZ.          UPPER SPURIOUS FREQ. LIMIT= 1256.50 MHZ.          LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -72.90 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   10.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   57

DISTRIBUTIONS:

        DISTRIBUTION TYPE     1          USED FOR RS               DISTRIBUTION          MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    1.10 DB.          UPPER DECILE VALUE=    1.90 DB.
          USER-SPECIFIED DISTRIBUTION POINTS.
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        DISTRIBUTION TYPE     1          USED FOR ROFR             DISTRIBUTION          MEDIAN ERROR=     .00 DB.
STANDARD ERROR=    5.70 DB.          UPPER DECILE VALUE=    9.40 DB.
          USER-SPECIFIED DISTRIBUTION POINTS.
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                 .00      .00      .00      .00      .00      .00      .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
```

(Page 9 of 9)

```
NOMENCLATURE= WEATHERRADAR           LOWER OPER. FREQ.= 9315.00 MHZ.          UPPER OPER. FREQ.= 9415.00 MHZ.
IF BW=   1.20 MHZ.          RF. IF=   30.00 MHZ.            IF SELECTIVITY FALLOFF=  100.00 DB/DEC
RF SELECTIVITY FALLOFF=  693.00 DB/DEC          IMAGE REJECTION=   3.33 DB.           SPURIOUS REJECTION=   61.40 DB.
LOWER SPURIOUS FREQ. LIMIT= 6572.00 MHZ.          UPPER SPURIOUS FREQ. LIMIT=14181.00 MHZ.          LOCAL OSCILLATOR POSITION= C
SENSITIVITY= -109.00 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   10.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   58

DISTRIBUTIONS:

        DISTRIBUTION TYPE    1          USED FOR RS              DISTRIBUTION          MEDIAN ERROR=    .00 DB.
STANDARD ERROR=    2.60 DB.          UPPER DECILE VALUE=    4.30 DB.
            USER-SPECIFIED DISTRIBUTION POINTS.
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        DISTRIBUTION TYPE    1          USED FOR ROFR            DISTRIBUTION          MEDIAN ERROR=    .00 DB.
STANDARD ERROR=    4.90 DB.          UPPER DECILE VALUE=    7.30 DB.
            USER-SPECIFIED DISTRIBUTION POINTS.
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)


NOMENCLATURE= DME                    LOWER OPER. FREQ.=  962.00 MHZ.          UPPER OPER. FREQ.= 1213.00 MHZ.
IF BW=    .39 MHZ.          RF. IF=   63.00 MHZ.            IF SELECTIVITY FALLOFF=   81.00 DB/DEC
RF SELECTIVITY FALLOFF=   61.00 DB/DEC          IMAGE REJECTION=  59.30 DB.           SPURIOUS REJECTION=   73.00 DB.
LOWER SPURIOUS FREQ. LIMIT=  558.70 MHZ.          UPPER SPURIOUS FREQ. LIMIT= 1831.00 MHZ.          LOCAL OSCILLATOR POSITION= C
SENSITIVITY=  -80.60 DBM.          SIGNAL TO INTERFERENCE THRESHOLD=   10.00 DB          AVFILE NUMERIC CODE IDENTIFIER=   59

DISTRIBUTIONS:

        DISTRIBUTION TYPE    1          USED FOR RS              DISTRIBUTION          MEDIAN ERROR=    .00 DB.
STANDARD ERROR=    6.40 DB.          UPPER DECILE VALUE=    9.60 DB.
            USER-SPECIFIED DISTRIBUTION POINTS.
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        DISTRIBUTION TYPE    1          USED FOR ROFR            DISTRIBUTION          MEDIAN ERROR=    .00 DB.
STANDARD ERROR=    8.90 DB.          UPPER DECILE VALUE=   15.00 DB.
            USER-SPECIFIED DISTRIBUTION POINTS.
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0. TO 0.3)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.35 TO 0.65)
                      .00     .00     .00     .00     .00     .00     .00 DB ERROR (AT PROBABILITY LEVELS 0.7 TO 1.0)

        (LEVEL VALUES OF ZERO IMPLY NON-USER SPECIFIED DISTRIBUTION)
```

APPENDIX E

ACTUAL PROGRAM RUN DECKS AND OUTPUT

INTRODUCTION

There are twenty-four *possible* types of AVPAK program executions, as shown in TABLE E-1. Each type of run is different with respect to the type of calculation desired (power density or INR), the type of analysis desired (cosite or intersite), the type of INR answer desired (deterministic, functional or probabilistic), or the coordinate system used for the inputs, (aircraft industry, cylindrical, or rectangular). Similarly, there are twelve *impossible* run type combinations, as shown in TABLE E-2.

SAMPLE RUN DECKS AND OUTPUT

Seven different AVPAK sample runs are discussed below. Each run corresponds to one or more of the twenty-four possible types. Together they exhibit extensive execution of the capabilities of the AVPAK model, and they provide the user with an illustration of actual sets of data cards. The output corresponding to each run is also shown.

SAMPLE RUN #1 (TYPE #17 ANALYSIS)[a]

This sample analysis involves one transmitter with a directional antenna on an aircraft and one receiver with an omnidirectional antenna on the ground. The input data cards are shown in Figure E-1, and describe the situation that follows.

General Parameter Data

This run is to perform an intersite, deterministic, interference-to-noise ratio analysis. Inputs are in the rectangular, (X,Y,Z), coordinate system. The radius of the fuselage, although not used in an intersite analysis, is given as 100 inches.

Intersite Data

Site 1 heading = 30°
Site 1 altitude = 11,560 feet
Site 2 heading = 0°
Site 2 altitude = 1.0 feet

---

[a]Refer to TABLE E-1 for description of types of runs.

TABLE E-1

ALLOWABLE RUN TYPES

Type	Calculation	Analysis	Answer	Coordinate System
1	Power Density	Cosite	N/A[a]	(B,W,F)
2	" "	"	"	(X,Y,Z)
3	" "	"	"	(ρ,θ,Z)
4	" "	Intersite	"	(B,W,F)
5	" "	"	"	(X,Y,Z)
6	" "	"	"	(ρ,θ,Z)
7	INR	Cosite	Deterministic	(B,W,F)
8	"	"	"	(X,Y,Z)
9	"	"	"	(ρ,θ,Z)
10	"	"	Functional	(B,W,F)
11	"	"	"	(X,Y,Z)
12	"	"	"	(ρ,θ,Z)
13	"	"	Probabilistic	(B,W,F)
14	"	"	"	(X,Y,Z)
15	"	"	"	(ρ,θ,Z)
16	"	Intersite	Deterministic	(B,W,F)
17	"	"	"	(X,Y,Z)
18	"	"	"	(ρ,θ,Z)
19	"	"	Functional	(B,W,F)
20	"	"	"	(X,Y,Z)
21	"	"	"	(ρ,θ,Z)
22	"	"	Probabilistic	(B,W,F)
23	"	"	"	(X,Y,Z)
24	"	"	"	(ρ,θ,Z)

[a]The answer-type terminology applies only to INR runs. With Power Density runs the terminology is not applicable.

TABLE E-2

IMPOSSIBLE RUN TYPES

Calculation	Analysis	Answer	Coordinate System
Power Density	Cosite	Functional	(B,W,F)
" "	"	"	(X,Y,Z)
" "	"	"	(ρ,θ,Z)
" "	"	Probabilistic	(B,W,F)
" "	"	"	(X,Y,Z)
" "	"	"	(ρ,θ,Z)
" "	Intersite	Functional	(B,W,F)
" "	"	"	(X,Y,Z)
" "	"	"	(ρ,θ,Z)
" "	"	Probabilistic	(B,W,F)
" "	"	"	(X,Y,Z)
" "	"	"	(ρ,θ,Z)

Intersite Data (Cont'd.)

Ground distance from site 1 to site 2 = 10.0 statute miles
True bearing from site 1 to site 2 = 050°
Platform indicators: site 1 = moving (airplane);
site 2 = fixed (ground)

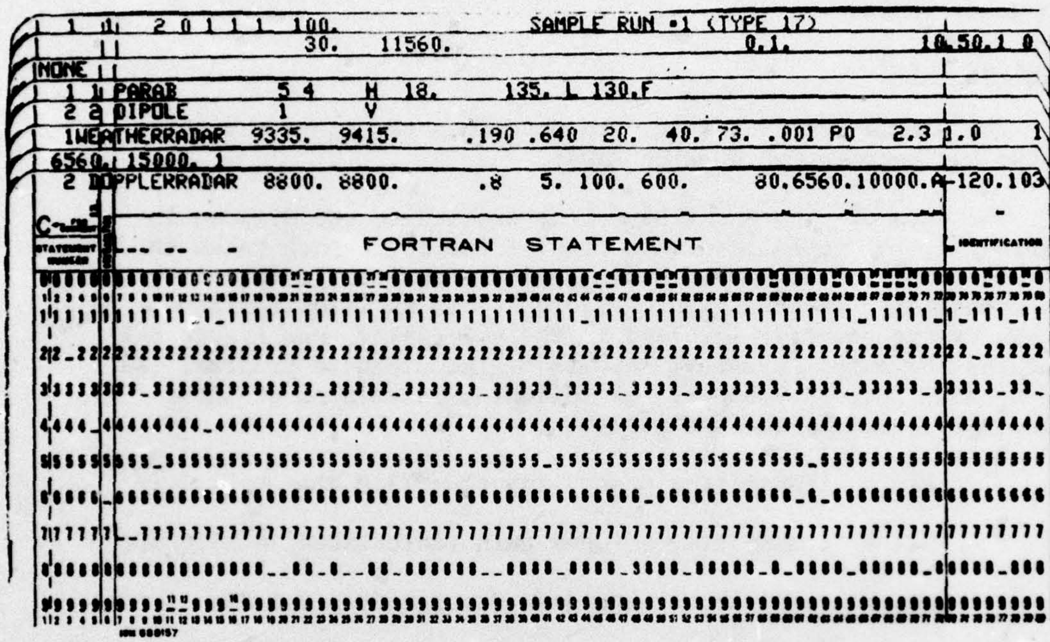

Figure E-1. Data card deck for Sample Run #1. (The top data card corresponds to the first card in the deck, etc.)

Obstruction Data

No obstructions are to be considered. Airfoil and pod obstructions are not treated in an intersite analysis; hence the card labeled 'NONE' is inserted in the deck. Fuselage obstructions are also not considered in an intersite analysis.

Antenna Data

The antenna at site number 1 is a horizontally polarized, circular aperture antenna mounted on the fuselage, and is 18 inches in diameter. The main beam roll angle is directed to the left 135° and the main beam pitch angle is directed forward at an angle of 130°.

The antenna for site number 2 is a vertically polarized dipole and is considered to be omnidrectional.

Transmitter Data

The single set of two transmitter data cards describe the characteristics of the equipment named WEATHER RADAR. The second data card of this set is required to enter the transmitter filter frequency limits.

Receiver Data

The single receiver data card describes the characteristics of the equipment named DOPPLER RADAR.

The data of Figure E-1 have been applied to the diagram in Figure E-2, to demonstrate a portion of the logic path taken for the determination of the off-axis angles, required to calculate the transmitter antenna gain. Figure E-3 is an illustration of the intersite geometry involved in the processing, and Figure E-4 contains the actual printout results of the executed program. As can be seen from the output, the following calculated or input values were used in the EMC analysis:

PT = transmitter power (input) = 73.0 dBm

GT = transmitter antenna gain (calculated) = 15.6 dBi

GR = receiver antenna gain (assigned) = 2.0 dBi

LP = site-to-site path loss (calculated) = 130.3 dB

LF = transmitter-receiver off-frequency rejection (calculated) = 80.0 dB

S/I = signal-to-interference ratio threshold (input) = 10.0 dB

RS = receiver sensitivity level (input) = -120.0 dBm

PI = interfering power level at the receiver input terminals (calculated)

= -140.8 dB.

It can be seen that two receiver characteristic values were reset or recovered by the program: an RF slope fall-off of 200 dB/decade and an image rejection of 60 dB.

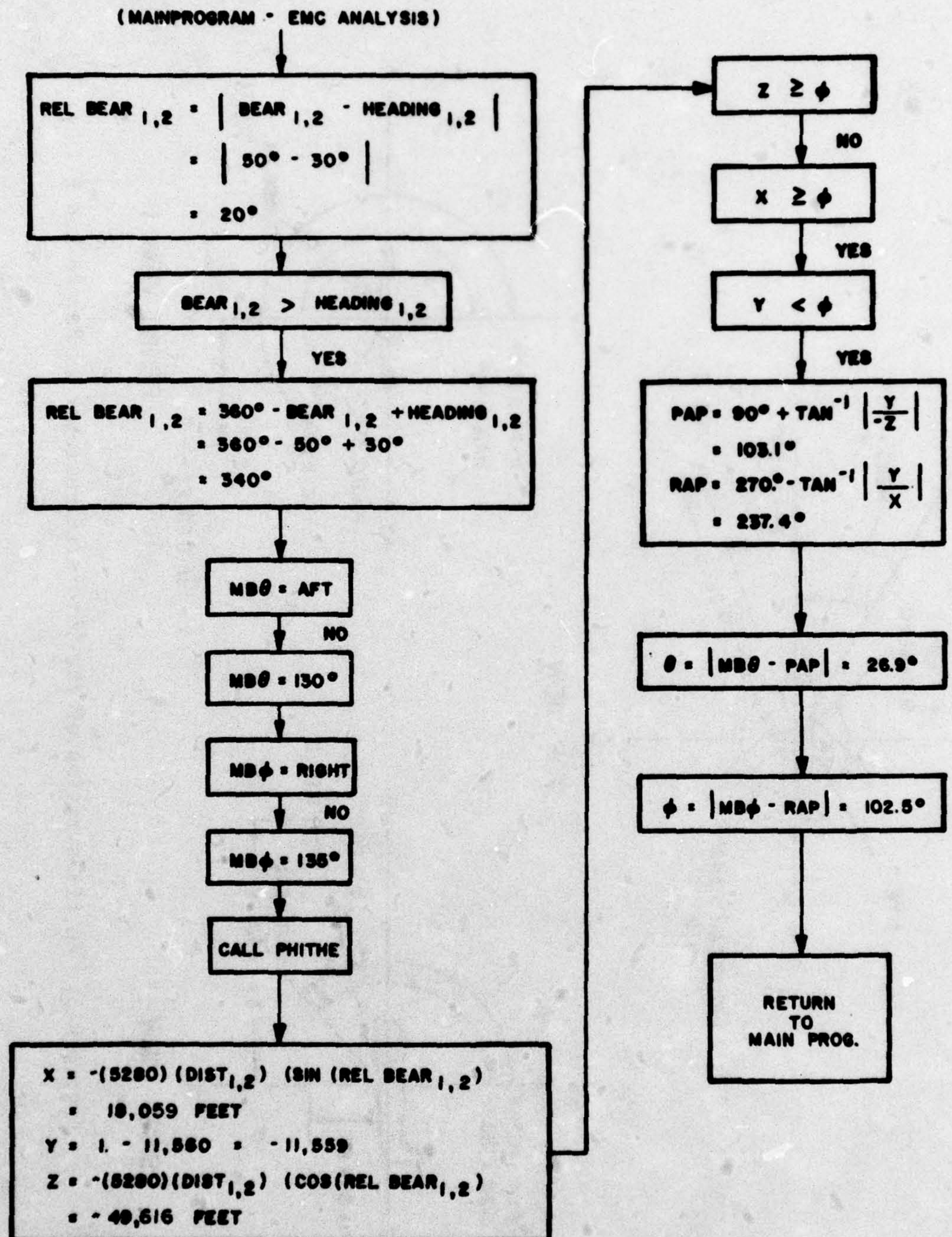

Figure E-2. Determination of the difference angles θ and ∅, between the transmitter antenna main beam and the transmitter-site to receiver-site path.

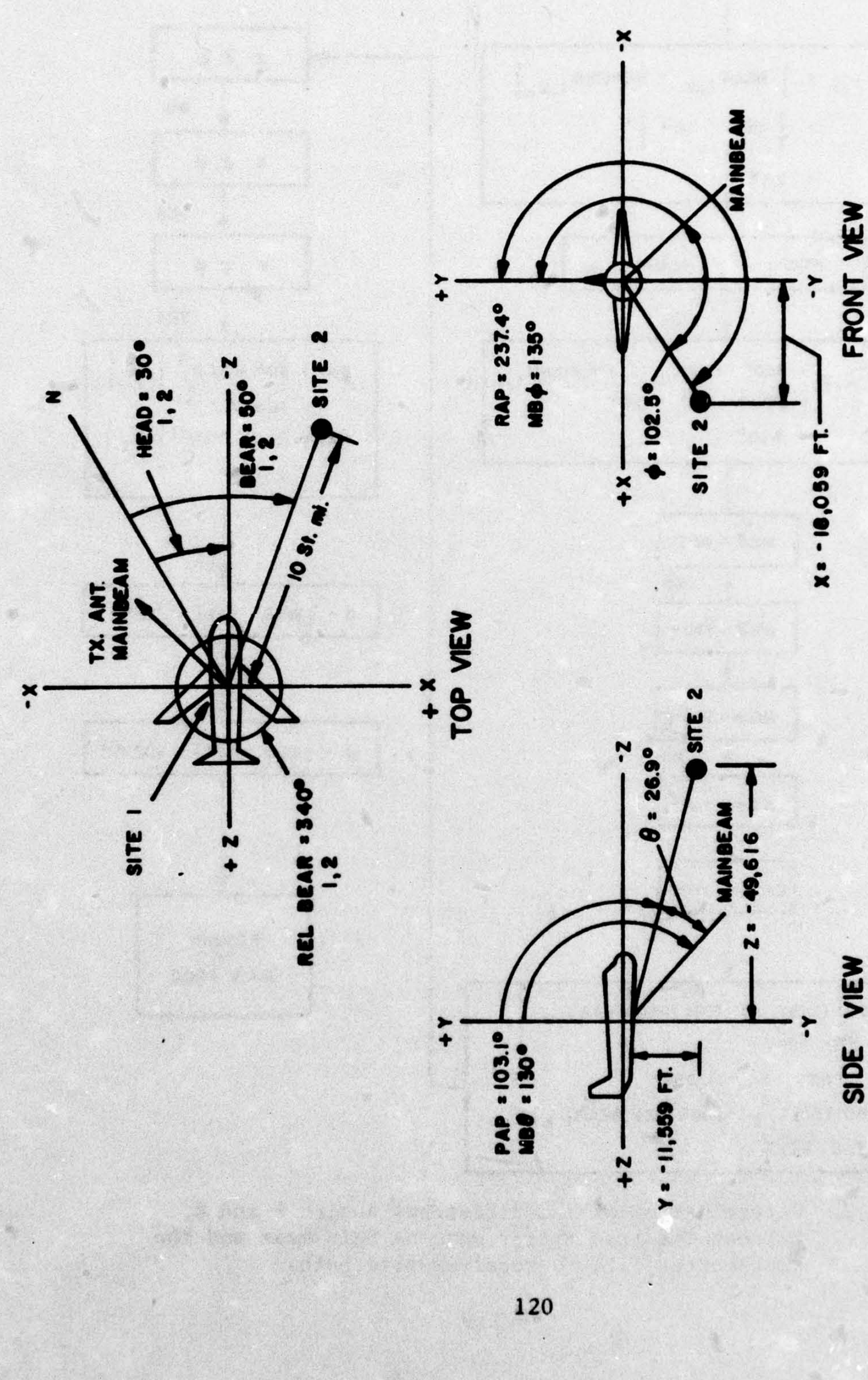

Figure E-3. An illustration of the intersite geometry of Sample Run #1.

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                         AVPAK3 PROGRAM OUTPUT
         PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
                         ANNAPOLIS, MARYLAND


     **** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN #1 (TYPE 17)

NO. OF TXS =  1      NO. OF RXS (OR POINTS) =   1      NO. OF ANTS =   2

TYPE OF CALCULATION DESIRED IS INT. TO NOISE RAT.

TYPE OF ANALYSIS DESIRED IS INTERSITE

TYPE OF ANSWER DESIRED IS DETERMINISTC

INPUTS ARE IN THE (X,Y,Z) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS =  100.00 IN.     BULKHEAD Z-DIST =      .00 IN.     BULKHEAD HEIGHT =      .00 IN.


     **** INTERSITE ANALYSIS PARAMETERS ****

SITE 1 IS MOVING

SITE 2 IS FIXED

HEADING OF SITE 1=  30.00 DEG.

HEADING OF SITE 2=    .00 DEG.

ALTITUDE OF SITE 1 =    11560.00 FT.

ALTITUDE OF SITE 2 =        1.00 FT.

GROUND DISTANCE BETWEEN SITES =   10.00 ST. MI.

BEARING FROM SITE 1 TO SITE 2=   50.00 DEG.

BEARING FROM SITE 2 TO SITE 1=  230.00 DEG.

VERTICAL ANGLE BETWEEN SITE 1 TO SITE 2 PATH=  -12.35 DEG.

VERTICAL ANGLE BETWEEN SITE 2 TO SITE 1 PATH=   12.35 DEG.

**** THERE ARE NO OTHER OBSTRUCTIONS TO BE CONSIDERED IN THIS ANALYSIS OTHER THAN THE AIRCRAFT FUSELAGE ****
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Figure E-4. Printout of Sample Run #1.
(Page 1 of 3)

TRANSMITTERS WITH GOOD DATA

ANT NO.	TRANSMITTER NOMENCLATURE	FREQ. (MHZ.) LOWER	FREQ. (MHZ.) UPPER	BW1 MHZ.	BW2 MHZ.	SF1 (DB/DEC.)	SF2 (DB/DEC.)	PWR. DBM.	MOD TYP	PCI	PW USEC	R/FT USEC	EDBW MHZ.	FILTER (MHZ.) LOWER	FILTER (MHZ.) UPPER	# H	HARMONIC SUPPRESSION LEVELS (DB.) HARMONIC NUMBER 2	3	4	5	6	7	8	9
1	WEATHERRADAR	9335.	9415.	.190	.640	20.0	40.0	73.	P0		2.3	1.0	.001	6560.	15000.	1	0.	0.	0.	0.	0.	0.	0.	0.

RX RF SLOPE FALLOFF OF 600.00 DB/DEC. WAS RESET TO 200. DB/DEC.

RX IMAGE REJECTION NOT GIVEN, VALUE OF 60. DB RECOVERED

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE	FREQ (MHZ.) LOWER	FREQ (MHZ.) UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IM REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	SPUR FREQS (MHZ.) UPPER	LO POS	SENS. (DBM)	S/I (DB)
2	DOPPLERRADAR	8800.	8800.	.800	5.	100.	200.	60.	8u.	6560.	10000.	A	-120.	10.

ANTENNAS WITH GOOD DATA

ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)	PITCH ANG. (DEG.)	ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	C O
1	1	PARAB	5	4	.0	H	10.0	.0	135. L	130.	.0	.0	.0	102.5	26.9	0
2	2	DIPOLE	1	0	2.0	V	.0	.0	0.	0.	.0	.0	.0	.0	.0	0

ANT. TYPE INDICATORS: 0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS: 1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO): 0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED

Figure E-4. (Page 2 of 3)

```
                EQUIPMENTS CAUSING POSSIBLE INTERFERENCE (EFFECTIVE POWER IS GREATER THAN RECEIVER SENSITIVITY)

RECEIVER     TRANSMITTER   PI  =   PT   +   GT   +   GR   -   LP   -   LF   +   S/I   =          >   RS      CODES

                           CULLED EQUIPMENTS (POWER IS LESS THAN RECEIVER SENSITIVITY)

RECEIVER     TRANSMITTER   PI  =   PT   +   GT   +   GR   -   LP   -   LF   +   S/I   =          <   RS      CODES

DOPPLERRADAR WEATHERRADAR  PI  =  73.0  + -15.6  +   2.0  -  130.0 -  80.0 +  10.0   = -140.6   <  -120.0   H=I


                   TABLE OF INTERFERING EQUIPMENTS (X=INTERFERING)

RECEIVERS                     TRANSMITTERS

              W
              E
              A
              T
              H
              E
              R
              R
              A
              D
              A
              R
              ..................................................
DOPPLERRADAR
              ..................................................

END OF JOB NO.    1
END OF RUN
```

Figure E-4. (Page 3 of 3)

SAMPLE RUN #2 (TYPE #1 RUN)

This sample analysis involves six transmitters and a single power density point, all on the same aircraft. The input data cards are shown in Figure E-5, and serve to describe an analysis that follows.

General Parameter Data

This run is to calculate the power density at a point on an aircraft, resulting from six collocated transmitters. The inputs are with respect to the aircraft industry's butt-line, water line, fuselage station, (B,W,F), coordinate system. The maximum fuselage radius is 140.32 inches. No bulkhead obstruction on the fuselage is assumed to exist.

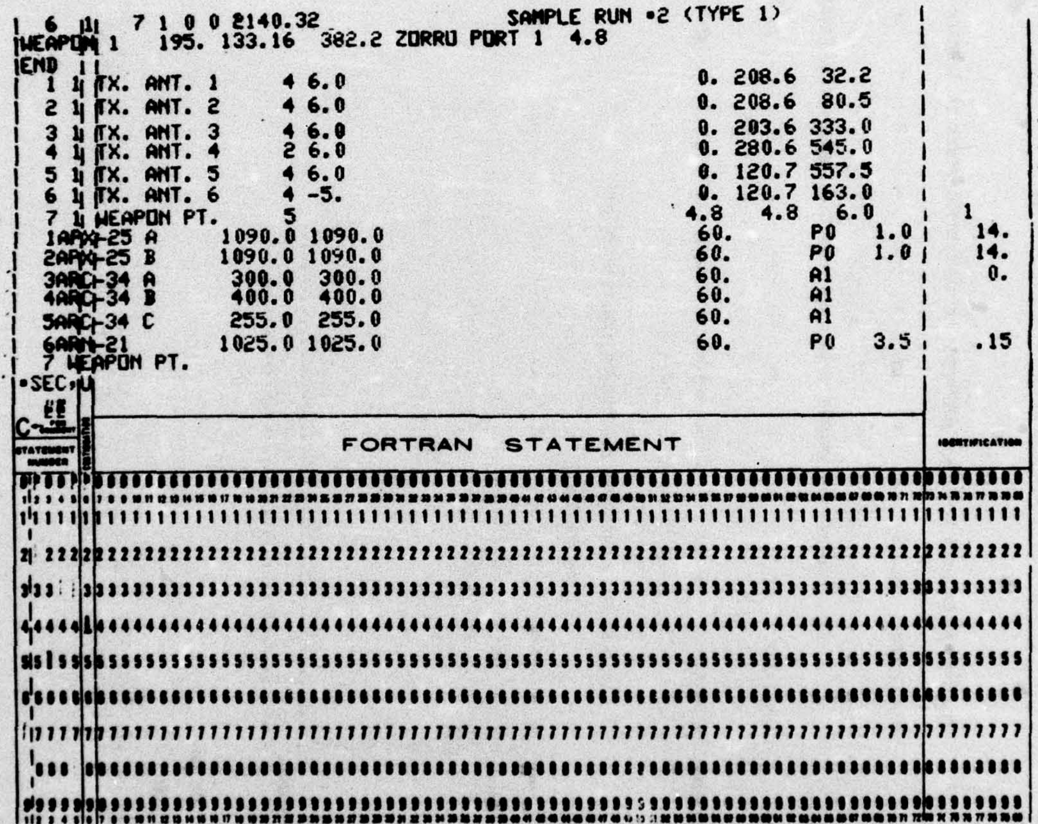

Figure E-5. Data card deck for Sample Run #2.

Pod Obstruction Data

One pod is to be considered in the analysis, ZORRO PORT 1. The nose-centroid of this pod is located at coordinates (195 inches, 133.16 inches, 382.2 inches) in the (B,W,F) coordinate system of the fuselage. The pod is assumed to be a cylinder of radius 4.8 inches.

Antenna and Power Density Point Data

Each transmitter is coupled to its own antenna. The antenna types are all undefined. One is mounted on the vertical stabilizer, and the others are mounted on the fuselage. One antenna has an input gain of -5 dBi, the others have an input gain of 6 dBi. The location of each antenna is given in the (B,W,F) coordinate sytem of the fuselage. The location of the power density point is specified with respect to the pod in the pod's (B,W,F) coordinate system.

Transmitter Data

The nomenclatures and characteristics of the six transmitters are given on six cards. Each transmitter is associated with a different antenna by use of a unique antenna identification number. Each transmitter frequency, power, and modulation type is specified. The peak transmitter power is 60 dBm for all equipments. The pulsewidth, pulse rise/fall times, and pulse repetition frequency for each of the pulsed (modulation type PO) transmitters are given.

The power density point data card specifies the nomenclature and point identification number Note that the power density point is treated the same as an antenna to simplify the correspondences of point nomenclature and point location coordinates. Obviously the antenna and equipment characteristic data are not applicable for the power density point, so that most data fields on both cards are blank.

Figures E-6 and E-7 illustrate the geometry of the power density analysis to be performed. Figure E-8 shows the results of the power density analysis. The expected peak and average power densities at the pod due to each transmitter individually, and then the cumulative power due to all transmitters are shown. Note that the peak power density computation is not appropriate for non-pulsed equipments. The field strengths in volts/meter corresponding to each power density level in dBm/meter^2 are also listed. Note that messages produced by the model indicate that buttline coordinates were not given for the six antenna locations.

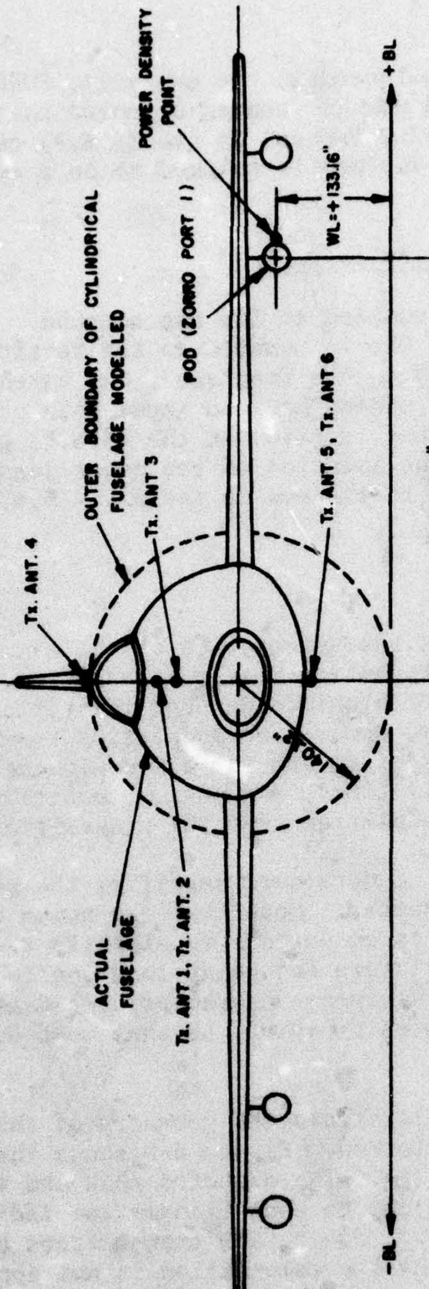

Figure E-6. Transmitter antenna and power density point configuration of Sample Run #2.

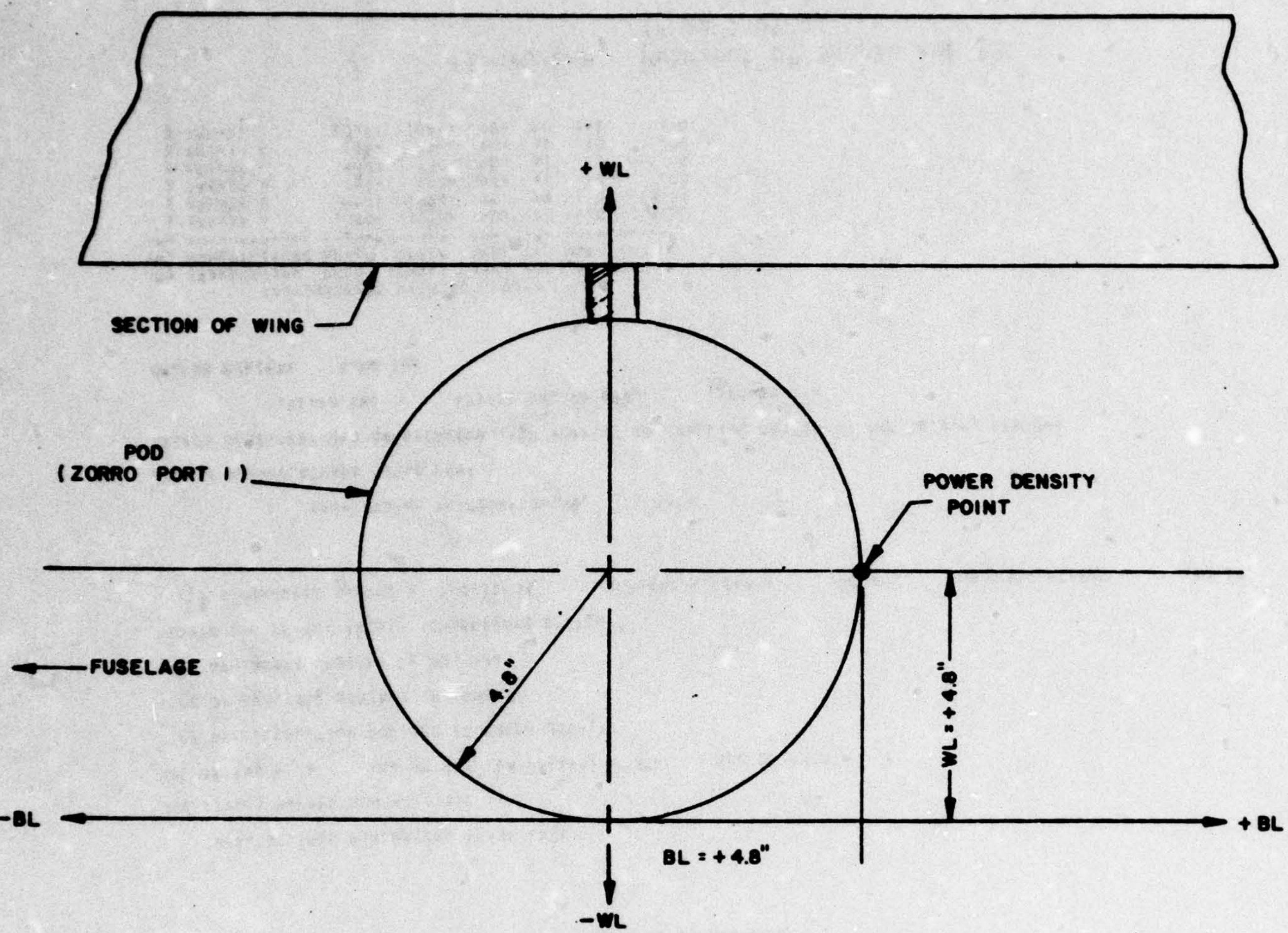

Figure E-7. Location of the power density point on the Pod "ZORRO PORT 1" in Sample Run #2.

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                    AVPAK3 PROGRAM OUTPUT
     PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
                    ANNAPOLIS, MARYLAND


     **** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN 02 (TYPE 1)

NO. OF TXS =  6     NO. OF RXS (OR POINTS) =   1     NO. OF ANTS =   7

TYPE OF CALCULATION DESIRED IS POWER DENSITY

TYPE OF ANALYSIS DESIRED IS COSITE

TYPE OF ANSWER DESIRED IS PD, W/A

INPUTS ARE IN THE (B,W,F) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS =  140.32 IN.     BULKHEAD Z-DIST =     .00 IN.     BULKHEAD HEIGHT =     .00 IN.


          **** WEAPON OBSTRUCTION NO.    1 ****

WEAPON NOMENCLATURE: ZORRO PORT 1

WEAPON NOSE-CENTROID COORDINATES WITH RESPECT TO FUSELAGE ORIGIN IN THE (B,W,F) SYSTEM:

          195.00 IN.       133.16 IN. OR DEG.       382.20 IN.

WEAPON RADIUS:    4.80 IN.


          TRANSMITTERS WITH GOOD DATA
ANT TRANSMITTER  FREQ. (MHZ.)  PWR. MOD  PW  PRF
NO. NOMENCLATURE LOWER  UPPER  DBM. TYP USEC KHZ.
--- ------------ ------------  ---- --- ---- -----
  1 APX-25 A     1090.  1090.  60.  PO  1.0  14.00
  2 APX-25 B     1090.  1090.  60.  PO  1.0  14.00
  3 ARC-39 A      300.   300.  60.  A1   .0    .00
  4 ARC-39 B      400.   400.  60.  A1   .0    .00
  5 ARC-39 C      255.   255.  60.  A1   .0    .00
  6 ARN-21_      1025.  1025.  60.  PO  3.5    .15
```

Figure E-8. Printout of Sample Run #2.
(Page 1 of 2)

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE	FREQ (MHZ.) LOWER	UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IM REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	UPPER	LO POS	SENS. (DBM)	S/I (DB)
7	WEAPON PT.	0.	0.	.000	0.	0.	0.	0.	0.	0.	0.		0.	0.

ANTENNAS WITH GOOD DATA

ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)	PITCH ANG. (DEG.)	ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	C O
1	1	TX. ANT. 1	0	4	6.0	X	.0	.0	0.	0.	.0	208.6	32.2	.0	.0	0
2	1	TX. ANT. 2	0	4	6.0	X	.0	.0	0.	0.	.0	208.6	80.5	.0	.0	0
3	1	TX. ANT. 3	0	4	6.0	X	.0	.0	0.	0.	.0	203.6	333.0	.0	.0	0
4	1	TX. ANT. 4	0	2	6.0	X	.0	.0	0.	0.	.0	208.6	545.0	.0	.0	0
5	1	TX. ANT. 5	0	4	6.0	X	.0	.0	0.	0.	.0	120.7	557.5	.0	.0	0
6	1	TX. ANT. 6	0	4	-5.0	X	.0	.0	0.	0.	.0	120.7	163.0	.0	.0	0
7	1	WEAPON PT.	0	5	.0		.0	.0	0.	0.	4.8	4.8	6.0	.0	.0	1

ANT. TYPE INDICATORS: 0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS: 1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO): 0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED

POWER DENSITIES

RX. OR POINT	TRANSMITTER	PD	=	PT	+	GT	-	LP	+	20LOG(F)	-	38.5		DBM/M**2		FLD. STRENGTH (V/M)
WEAPON PT.	APX-26 A	PD(PEAK)	=	60.0	+	6.0	-	58.8	+	60.7	-	38.5	=	29.4	=	18.2
WEAPON PT.	APX-26 A	PD(AVG.)	=	41.5	+	6.0	-	58.8	+	60.7	-	38.5	=	10.9	=	2.1
WEAPON PT.	APX-26 B	PD(PEAK)	=	60.0	+	6.0	-	58.2	+	60.7	-	38.5	=	30.0	=	19.5
WEAPON PT.	APX-26 B	PD(AVG.)	=	41.5	+	6.0	-	58.2	+	60.7	-	38.5	=	11.5	=	2.3
WEAPON PT.	ARC-34 A	PD(PEAK)	=	TX. MOD. TYPE A1 IS NOT PULSED SO THERE IS NO PEAK POWER DENSITY												
WEAPON PT.	ARC-34 A	PD(AVG.)	=	60.0	+	6.0	-	40.5	+	49.5	-	38.5	=	36.6	=	41.9
WEAPON PT.	ARC-34 B	PD(PEAK)	=	TX. MOD. TYPE A1 IS NOT PULSED SO THERE IS NO PEAK POWER DENSITY												
WEAPON PT.	ARC-34 B	PD(AVG.)	=	60.0	+	6.0	-	50.3	+	52.0	-	38.5	=	29.2	=	17.7
WEAPON PT.	ARC-34 C	PD(PEAK)	=	TX. MOD. TYPE A1 IS NOT PULSED SO THERE IS NO PEAK POWER DENSITY												
WEAPON PT.	ARC-34 C	PD(AVG.)	=	60.0	+	6.0	-	39.7	+	48.1	-	38.5	=	35.9	=	38.9
WEAPON PT.	ARN-21	PD(PEAK)	=	60.0	+	-5.0	-	55.2	+	60.2	-	38.5	=	21.5	=	7.3
WEAPON PT.	ARN-21	PD(AVG.)	=	27.2	+	-5.0	-	55.2	+	60.2	-	38.5	=	-11.3	=	.2

CUMULATIVE AVERAGE POWER DENSITY DUE TO ALL TXS. = 39.7 = 59.3

Figure E-8. (Page 2 of 2)

These particular messages are diagnostics for the user's benefit, but should not be of any concern in this analysis, as the butt-line dimensions of all antennas were intended to be zero.

SAMPLE RUN #3 (TYPE #9 RUN)

The data cards for this sample run, shown in Figure E-9, describe an analysis to be performed that follows.

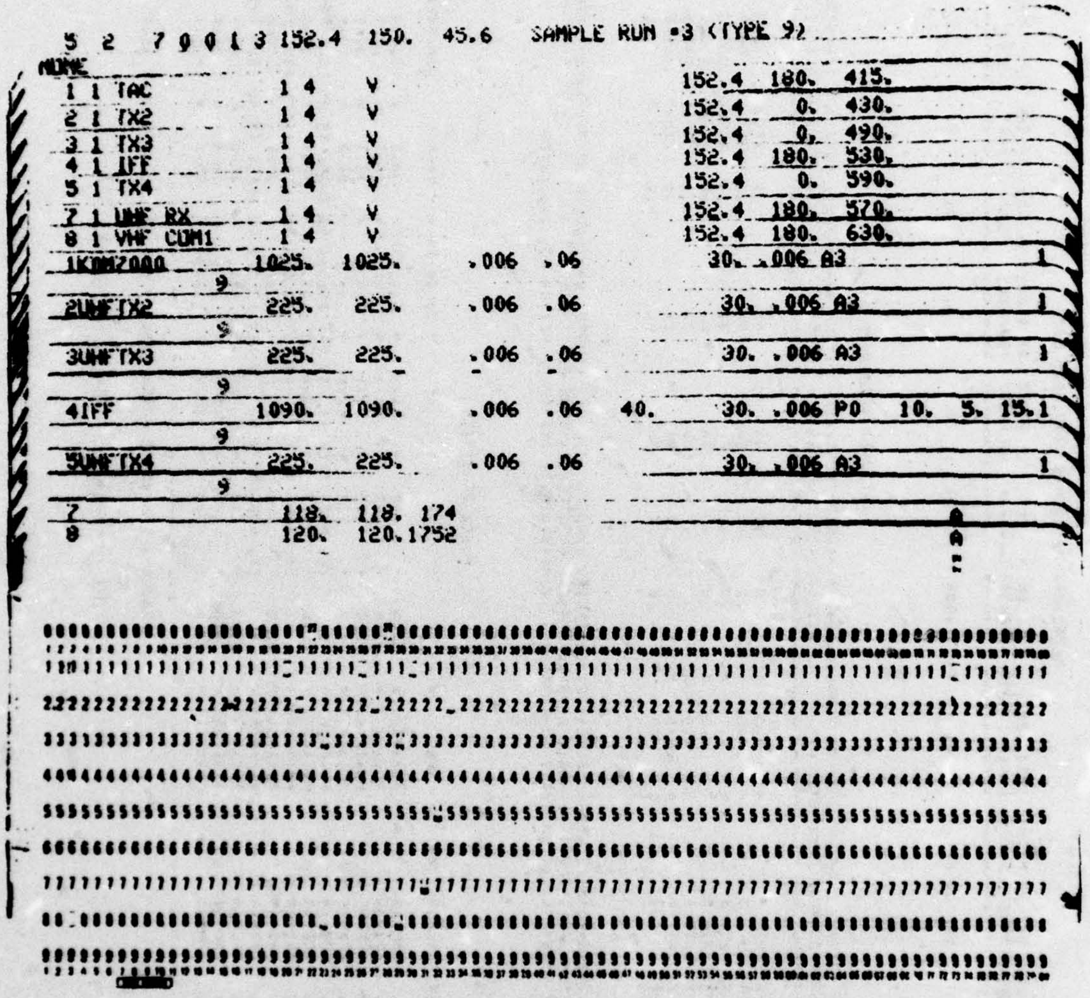


Figure E-9. Data card deck for Sample Run #3.

General Parameters

This run is to perform a cosite, deterministic, INR analysis of five transmitters and two receivers. Input units are to be in the cylindrical (ρ, θ, Z) coordinate system. The maximum fuselage radius is 152.4 inches. A bulkhead obstruction with a height of 45.6 inches exists 150.0 inches aft of the fuselage nose. There are no wing or pod obstructions to be considered in the analysis.

Antenna Data

Each equipment uses a different antenna. All antennas are vertically polarized, fuselage-mounted dipoles. The locations of the seven antennas are specified in the ρ, θ, Z coordinate system. The seven antennas are numbered: 1, 2, 3, 4, 5, 7, and 8.

Transmitter Data

The five transmitters are tuned to 225, 1025, or 1090 MHz. All transmitters are assumed to have the same first and second emission bandwidth, power, and number of harmonics to be considered in the analysis. All transmitters except the IFF are assumed to have the same falloff characteristics and modulation types.

Receiver Data

One receiver is tuned to 118 MHz and the other to 120 MHz. The local oscillator tracks above the tuned frequency for both receivers. All other receiver characteristics are to be retrieved from the AVBASE file from those records with identification numbers 174 and 1752.

The results of the INR analysis are shown in Figure E-10. Note that no transmitter-receiver combinations are potential interference problems, as all ten combinations are assumed to be interference-free. All values for the terms in the interference expression are calculated as being equal except for the path losses and off-frequency rejections. The first harmonic (fundamental) was determined to be the most critical transmitting frequency to be considered in calculating the off-frequency rejections.

The locations of the antennas on the fuselage are shown in the diagram of Figure E-11, along with the calculated path losses. As in Sample Run #2, several diagnostic messages pertaining to antenna location data are printed. Also listed are the transmitter

```
                              AVPAK3 PROGRAM OUTPUT
            PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
                               ANNAPOLIS, MARYLAND


    **** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN #3 (TYPE 9)

NO. OF TXS =  5     NO. OF RXS (OR POINTS) =   2     NO. OF ANTS =   7

TYPE OF CALCULATION DESIRED IS INT. TO NOISE RAT.

TYPE OF ANALYSIS DESIRED IS COSITE

TYPE OF ANSWER DESIRED IS DETERMINISTC

INPUTS ARE IN THE (R,T,Z) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS =  152.40 IN.     BULKHEAD Z-DIST =  150.00 IN.     BULKHEAD HEIGHT =   45.60 IN.


**** THERE ARE NO OTHER OBSTRUCTIONS TO BE CONSIDERED IN THIS ANALYSIS OTHER THAN THE AIRCRAFT FUSELAGE ****


TRANSMITTER POWER NOT GIVEN
TRANSMITTER KDM7000      WILL NOT BE CONSIDERED IN THIS ANALYSIS

FIRST TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. UHFTX2
VALUE OF    80.00 DB/DEC. WAS RECOVERED

SECOND TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. UHFTX2
VALUE OF    20.00 DB/DEC. WAS RECOVERED

FIRST TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. UHFTX3
VALUE OF    80.00 DB/DEC. WAS RECOVERED

SECOND TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. UHFTX3
VALUE OF    20.00 DB/DEC. WAS RECOVERED

SECOND TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. IFF
VALUE OF    40.00 DB/DEC. WAS RECOVERED

FIRST TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. UHFTX4
VALUE OF    80.00 DB/DEC. WAS RECOVERED

SECOND TX SLOPE FALLOFF LESS THAN 20. DB/DEC. FOR TX. UHFTX4
VALUE OF    20.00 DB/DEC. WAS RECOVERED
```

Figure E-10. Printout of Sample Run #3.
(Page 1 of 3)

TRANSMITTERS WITH GOOD DATA

ANT NO.	TRANSMITTER NOMENCLATURE	FREQ. (MHZ.) LOWER	UPPER	BW1 MHZ.	BW2 MHZ.	SF1 (DB/DEC.)	SF2	PWR. DBM.	MOD TYP	PCI	PW USEC	R/FT USEC	EDBW MHZ.	FILTER (MHZ.) LOWER	UPPER	N H	HARMONIC SUPPRESSION LEVELS (DB.) HARMONIC NUMBER 2	3	4	5	6	7	8	9
2	UHFTX2	225.	225.	.006	.060	80.0	20.0	30.	A3		.0	.000	.006	0.	0.	9	60.	60.	60.	60.	60.	60.	60.	60.
3	UHFTX3	225.	225.	.006	.060	80.0	20.0	30.	A3		.0	.000	.006	0.	0.	9	60.	60.	60.	60.	60.	60.	60.	60.
4	IFF	1090.	1090.	.006	.060	40.0	40.0	30.	PO		10.0	5.0	.006	0.	0.	9	60.	60.	60.	60.	60.	60.	60.	60.
5	UHFTX4	225.	225.	.006	.060	80.0	20.0	30.	A3		.0	.000	.006	0.	0.	9	60.	60.	60.	60.	60.	60.	60.	60.

```
THE INTERPRETATION OF MEANINGLESS INPUT WAS ATTEMPTED.
THE FOLLOWING RECORD IS ERRONEOUS OR DOES NOT CORRESPOND TO FORMAT SPECIFICATIONS:
 7            118.  118. 170                                            A
I/O  CALLED  AT  SEQUENCE  NUMBER 002060  OF  MAIN PROGRAM

THE INTERPRETATION OF MEANINGLESS INPUT WAS ATTEMPTED.
THE FOLLOWING RECORD IS ERRONEOUS OR DOES NOT CORRESPOND TO FORMAT SPECIFICATIONS:
 8            120.  120.1750                                            A
I/O  CALLED  AT  SEQUENCE  NUMBER 002060  OF  MAIN PROGRAM
```

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE		FREQ (MHZ.) LOWER	UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IM REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	UPPER	LO POS	SENS. (DBM)	S/ (I
7	RT831A(N)	C	118.	118.	.021	23.	300.	160.	20.	60.	80.	180.	A	-101.	1(
8	RT771	C	120.	120.	.028	20.	230.	100.	22.	70.	1.	260.	A	-101.	1(

ANTENNAS WITH GOOD DATA

ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)	PITCH ANG. (DEG.)	ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	C O
1	1	TAC	1	4	.0	V	.0	.0	0.	0.	152.4	180.0	415.0	.0	.0	0
2	1	TX2	1	4	2.0	V	.0	.0	0.	0.	152.4	.0	430.0	.0	.0	0
3	1	TX3	1	4	2.0	V	.0	.0	0.	0.	152.4	.0	490.0	.0	.0	0
4	1	IFF	1	4	2.0	V	.0	.0	0.	0.	152.4	180.0	530.0	.0	.0	0
5	1	TX4	1	4	2.0	V	.0	.0	0.	0.	152.4	.0	590.0	.0	.0	0
7	1	UHF RX	1	4	2.0	V	.0	.0	0.	0.	152.4	180.0	570.0	.0	.0	0
8	1	VHF COM1	1	4	2.0	V	.0	.0	0.	0.	152.4	180.0	630.0	.0	.0	0

ANT. TYPE INDICATORS: 0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS: 1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO): 0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED

Figure E-10. (Page 2 of 3)

```
            EQUIPMENTS CAUSING POSSIBLE INTERFERENCE (EFFECTIVE POWER IS GREATER THAN RECEIVER SENSITIVITY)

RECEIVER   TRANSMITTER  PI =   PT  +   GT  +   GR  -   LP  -   LF  +  S/I  =          >    RS     CODES

                              CULLED EQUIPMENTS (POWER IS LESS THAN RECEIVER SENSITIVITY)

RECEIVER   TRANSMITTER  PI =   PT  +   GT  +   GR  -   LP  -   LF  +  S/I  =          <    RS     CODES


RT831A(N)  C UHFTX2     PI =  30.0 +  2.0  +  2.0  -  78.4 - 145.6 +  10.0 = -180.0  <  -101.0   H=1
RT831A(N)  C UHFTX3     PI =  30.0 +  2.0  +  2.0  -  78.5 - 145.6 +  10.0 = -180.2  <  -101.0   H=1
RT831A(N)  C IFF        PI =  30.0 +  2.0  +  2.0  -  33.3 - 221.8 +  10.0 = -211.1  <  -101.0   H=1
RT831A(N)  C UHFTX4     PI =  30.0 +  2.0  +  2.0  -  78.6 - 145.6 +  10.0 = -180.2  <  -101.0   H=1

RT771      C UHFTX2     PI =  30.0 +  2.0  +  2.0  -  78.1 -  70.0 +  10.0 = -104.1  <  -101.0   H=1
RT771      C UHFTX3     PI =  30.0 +  2.0  +  2.0  -  78.4 -  70.0 +  10.0 = -104.4  <  -101.0   H=1
RT771      C IFF        PI =  30.0 +  2.0  +  2.0  -  41.3 - 219.2 +  10.0 = -216.5  <  -101.0   H=1
RT771      C UHFTX4     PI =  30.0 +  2.0  +  2.0  -  78.6 -  70.0 +  10.0 = -104.6  <  -101.0   H=1


                TABLE OF INTERFERING EQUIPMENTS (X=INTERFERING)

RECEIVERS              TRANSMITTERS


             UUIU
             HHFH
             FFFF
             TT T
             XX X
             23 4



             .................................................
RT831A(N)  C
RT771      C
             .................................................


END OF JOB NO.   1

END OF RUN
```

Figure E-10. (Page 3 of 3)

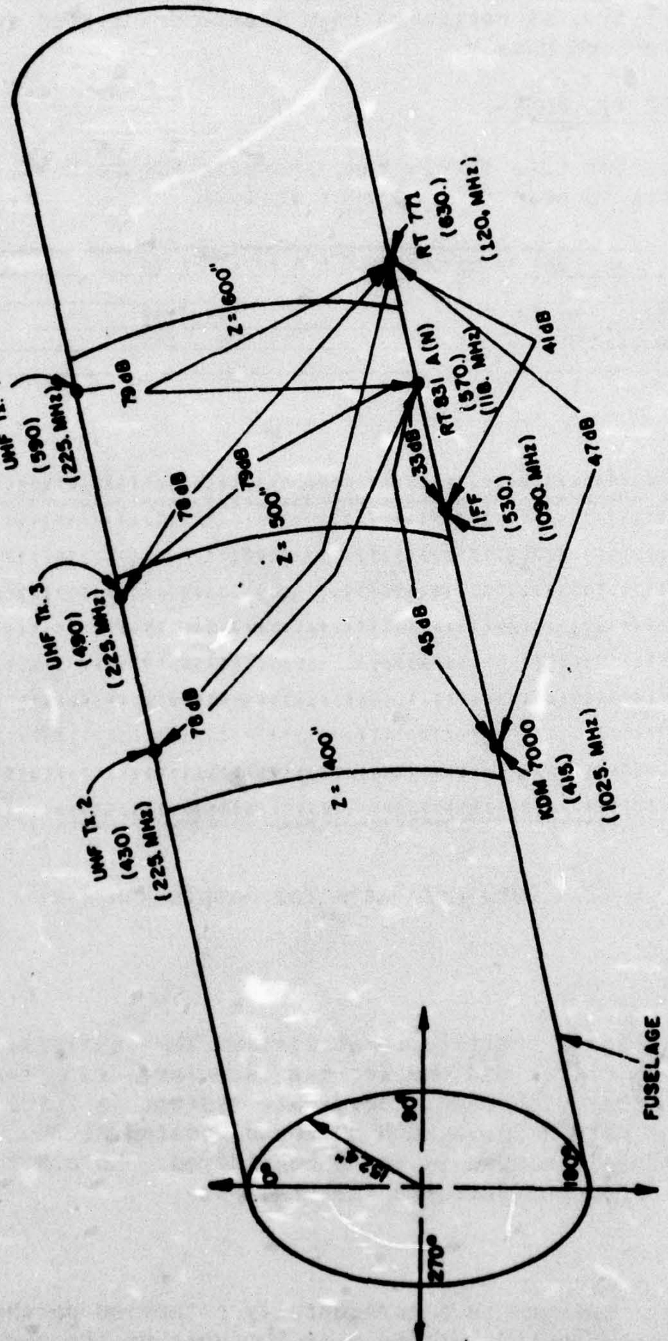


Figure E-11. Antenna locations and corresponding path losses for the cosite analysis of Sample Run #3.

spectral slope fall-off values recovered in the program. The receiver characteristics as retrieved from AVBASE are listed under the "Receivers with Good Data."

SAMPLE RUN #4 (TYPE #15 RUN)

The data cards for this sample run, shown in Figure E-12, describe an analysis to be performed that follows.

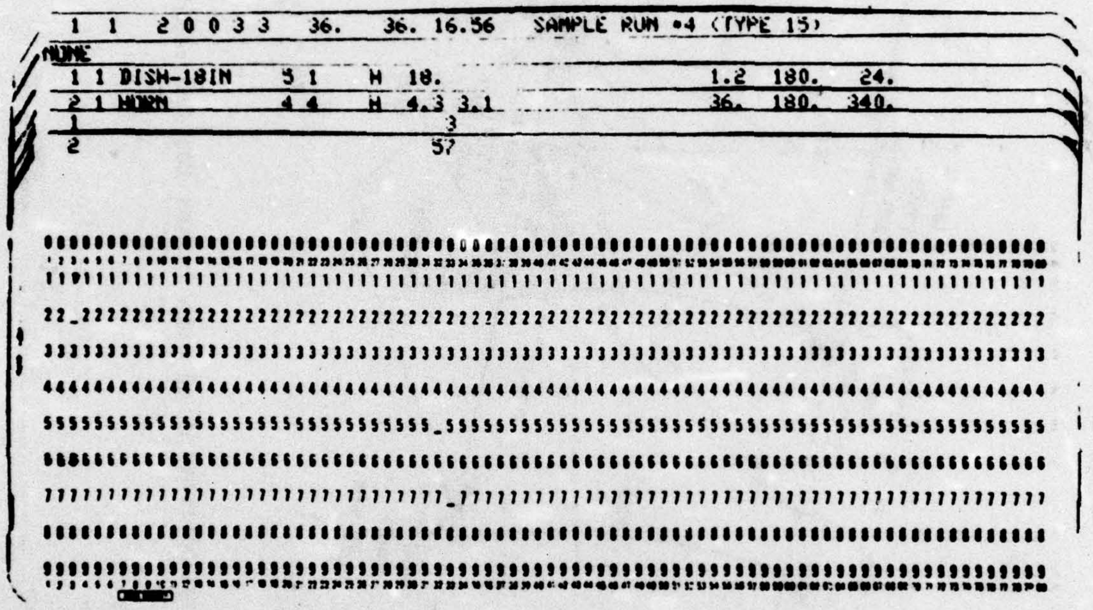


Figure E-12. Data card deck for Sample Run #4.

General Parameters

This sample is for a cosite, *probabilistic*, INR analysis. In this run one transmitter and one receiver are involved. The input units are in the cylindrical coordinate system. A fuselage of 36 inches radius with a 16.56-inch bulkhead located at 36 inches aft of the fuselage nose is to be considered. No other obstructions are to be considered in the analysis.

Antenna Data

The transmitter antenna ia a horizontally polarized parabolic antenna 18 inches in diameter located near the nose of the aircraft, forward of the bulkhead obstruction. The receiver antenna

is a horizontally polarized horn antenna, with an aperture of 4.3 inches by 3.1 inches, and it is mounted on the fuselage aft of the bulkhead obstruction.

Transmitter Data

The transmitter uses antenna number 1. The equipment characteristics are to be retrieved from the AVFILE record whose identification number is 3.

Receiver Data

The receiver uses antenna number 2. The equipment characteristics are to be retrieved from the AVFILE record whose identification number is 57.

The locations of the two antennas on the fuselage with respect to the bulkhead are shown in Figure E-13. The output from Sample Run #4 is shown in Figure E-14. The transmitter and receiver characteristics retrieved from AVFILE are listed.

Because the receiver input power level of -213.0 dBm does not exceed the receiver sensitivity of -72.9 dBm, the predicted probability of interference vs. dB error is not plotted. The table of interfering equipments shows no potential interference between the two equipments.

SAMPLE RUN #5 (TYPE #14 RUN)

The data cards for this sample run, shown in Figure E-15, describe the following analysis.

General Parameters

Similar to Sample Run #4, this run is a cosite, probabilistic, INR analysis. In this analysis, however, the inputs are in the rectangular, (X,Y,Z), coordinate system, and no bulkhead obstruction is to be considered. The fuselage radius is 240 inches. No wings or pods are to be considered.

Antenna Data

The transmitter antenna is a vertically polarized, parabolic antenna with a 12-inch aperture, mounted on the fuselage. The receiving antenna is an unspecified type, mounted on the fuselage with a gain value of 3 dBi. The type is unspecified since a gain value is entered.

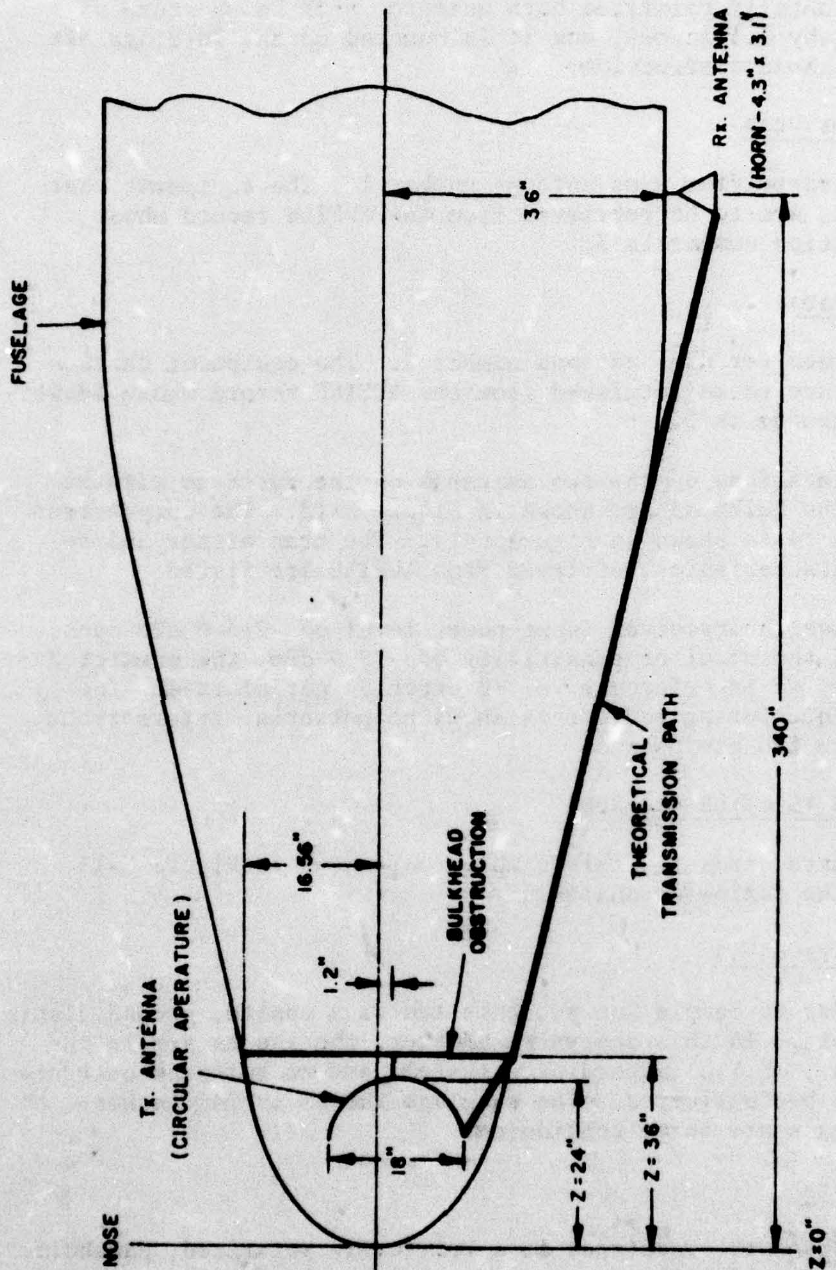


Figure E-13. Location of the two antennas of Sample Run #4.

AVPAKS PROGRAM OUTPUT
PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
ANNAPOLIS, MARYLAND

**** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN #4 (TYPE 15)

NO. OF TXS = 1 NO. OF RXS (OR POINTS) = 1 NO. OF ANTS = 2

TYPE OF CALCULATION DESIRED IS INT. TO NOISE RAT.

TYPE OF ANALYSIS DESIRED IS COSITE

TYPE OF ANSWER DESIRED IS PROBABILISTC

INPUTS ARE IN THE (R,T,Z) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS = 36.00 IN. BULKHEAD Z-DIST = 36.00 IN. BULKHEAD HEIGHT = 16.56 IN.

**** THERE ARE NO OTHER OBSTRUCTIONS TO BE CONSIDERED IN THIS ANALYSIS OTHER THAN THE AIRCRAFT FUSELAGE ****

TRANSMITTERS WITH GOOD DATA

ANT NO.	TRANSMITTER NOMENCLATURE	FREQ. (MHZ.) LOWER	UPPER	BW1 MHZ.	BW2 MHZ.	SF1 (DB/DEC.)	SF2	PWR. DBM.	MOD TYP	PCI	PW USEC	R/FT USEC	EDBW MHZ.	FILTER (MHZ.) LOWER	UPPER	# H	HARMONIC SUPPRESSION LEVELS (DB.) HARMONIC NUMBER 2	3	4	5	6	7	8	9
1	WEATHERRADAR	9315.	9415.	.204	3.3	20.0	42.0	73.	PO		3.1	.194	3.4	6456.	15230.	2	61.	0.	0.	0.	0.	0.	0.	0.

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE	FREQ (MHZ.) LOWER	UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IN REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	UPPER	LO POS	SENS. (DBM)	S/I (DB)
2	ATC XPONDER	1030.	1030.	6.2	6C.	73.	66.	67.	81.	828.	1256.	C	-73.	10.

ANTENNAS WITH GOOD DATA

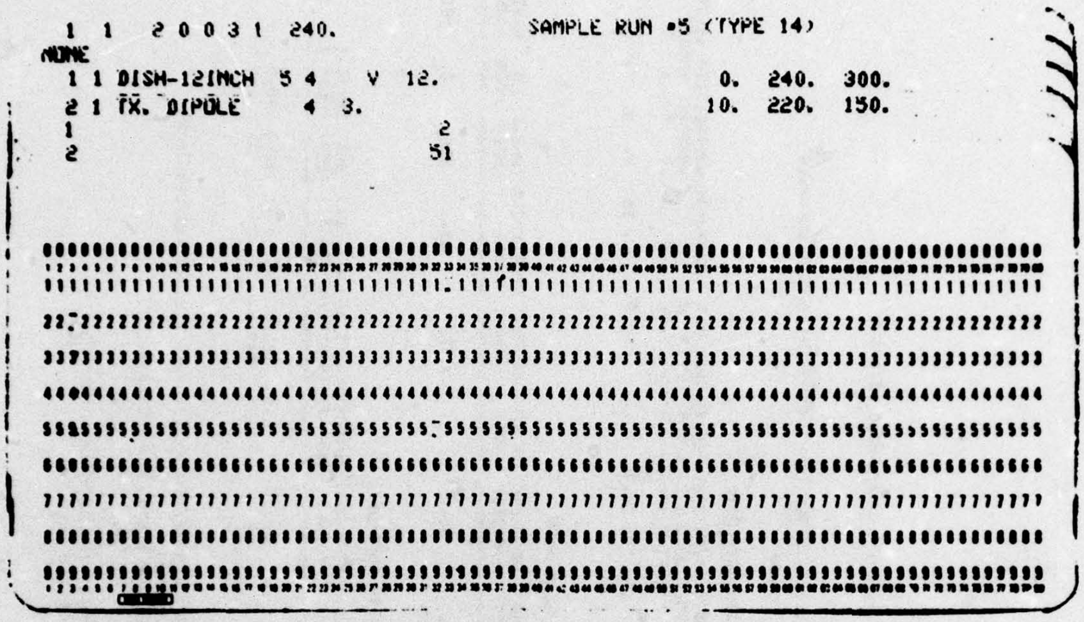
ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)	PITCH ANG. (DEG.)	ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	CO
1	1	DISH-18IN	5	1	.0	H	18.0	.0	0.	0.	1.2	180.0	24.0	90.0	90.0	0
2	1	HORN	4	4	.0	H	4.3	3.1	0.	0.	36.0	180.0	340.0	90.0	90.0	0

ANT. TYPE INDICATORS: 0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS: 1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO): 0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED

Figure E-14. Printout of Sample Run #4.
(Page 1 of 2)

```
              EQUIPMENTS CAUSING POSSIBLE INTERFERENCE (BASED UPON UPPER DECILE PI PARAMETERS)
      **** PI BELOW IS THE EFFECTIVE MEDIAN INTERFERENCE POWER FOR THE FUNCTIONAL CLASSES ANALYZED ****

RECEIVER     TRANSMITTER   PI =  PT  +  GT  +  GR  -  LP  -  LF  +  S/I  =          >  RS ?  CODES


                         CULLED EQUIPMENTS (POWER IS LESS THAN RECEIVER SENSITIVITY)

RECEIVER     TRANSMITTER   PI =  PT  +  GT  +  GR  -  LP  -  LF  +  S/I  =          <  RS    CODES

ATC XPONDER  WEATHERRADAR  PI = 73.0 + -15.6 + 1.9 - 98.1 - 306.8 + 10.0 = -335.5   <  -72.9 M=1


              TABLE OF INTERFERING EQUIPMENTS (X=INTERFERING)

RECEIVERS              TRANSMITTERS

               W
               E
               A
               T
               H
               E
               R
               R
               A
               D
               A
               R
               ..............................................
ATC XPONDER
               ..............................................

END OF JOB NO.   1
END OF RUN
```

Figure E-14. (Page 2 of 2)



```
 1  1   2 0 0 3 1  240.                SAMPLE RUN #5 (TYPE 14)
NONE
 1 1 DISH-12INCH  5 4    V  12.                         0.  240.  300.
 2 1 TX. DIPOLE     4  3.                              10.  220.  150.
 1                             2
 2                            51
```

Figure E-15. Data cards for Sample Run #5.

The transmitter uses antenna number 1 and has the characteristics of the AVFILE record with identification number 2. The receiver uses antenna number 2 and has the characteristics of the AVFILE record with identification number 51.

The output for Sample Run #5 is shown in Figure E-16. Since the effective median interference power of -104.2 dBm and the upper decile cull correction factor both exceed the receiver sensitivity, the predicted probability of interference vs. dB error is plotted. The actual coordinates of 21 points on the graph are also printed. The table of interfering equipments notes that these two equipments are a potential source of interference.

SAMPLE RUN #6 (TYPE #3 RUN)

The data card deck for this sample run is shown in Figure E-17. This run performs a cosite, power density analysis among five transmitters and four power density points. Inputs are to be in the cylindrical, (ρ, θ, Z), coordinate system. The maximum fuselage radius is 100 inches.

```
**** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN #8 (TYPE 14)

NO. OF TXS = 1     NO. OF RXS (OR POINTS) =  1     NO. OF ANTS =  2

TYPE OF CALCULATION DESIRED IS INT. TO NOISE RAT.

TYPE OF ANALYSIS DESIRED IS COSITE

TYPE OF ANSWER DESIRED IS PROBABILISTC

INPUTS ARE IN THE (X,Y,Z) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS =  240.00 IN.     BULKHEAD Z-DIST =     .00 IN.     BULKHEAD HEIGHT =     .00 IN.

**** THERE ARE NO OTHER OBSTRUCTIONS TO BE CONSIDERED IN THIS ANALYSIS OTHER THAN THE AIRCRAFT FUSELAGE ****
```

TRANSMITTERS WITH GOOD DATA

ANT NO.	TRANSMITTER NOMENCLATURE	FREQ. (MHZ.) LOWER	UPPER	BW1 MHZ.	BW2 MHZ.	SF1 (DB/DEC.)	SF2	PWR. DBM.	MOD TYP	PCI	PW USEC	R/FT USEC	EDBW MHZ.	FILTER (MHZ.) LOWER	UPPER	# H	HARMONIC SUPPRESSION LEVELS (DB.) HARMONIC NUMBER 2	3	4	5	6	7	8	9
1	ATC.XPONDER	1090.	1090.	1.5	7.8	20.0	40.0	55.	PO		.4	.082	11.9	0.	0.	3	73.	90.	0.	0.	0.	0.	0.	0.

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE	FREQ (MHZ.) LOWER	UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IM REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	UPPER	LO POS	SENS. (DBM)	S/I (DB)
2	VL TWO	108.	118.	.032	26.	140.	66.	72.	97.	22.	244.	C	-99.	20.

ANTENNAS WITH GOOD DATA

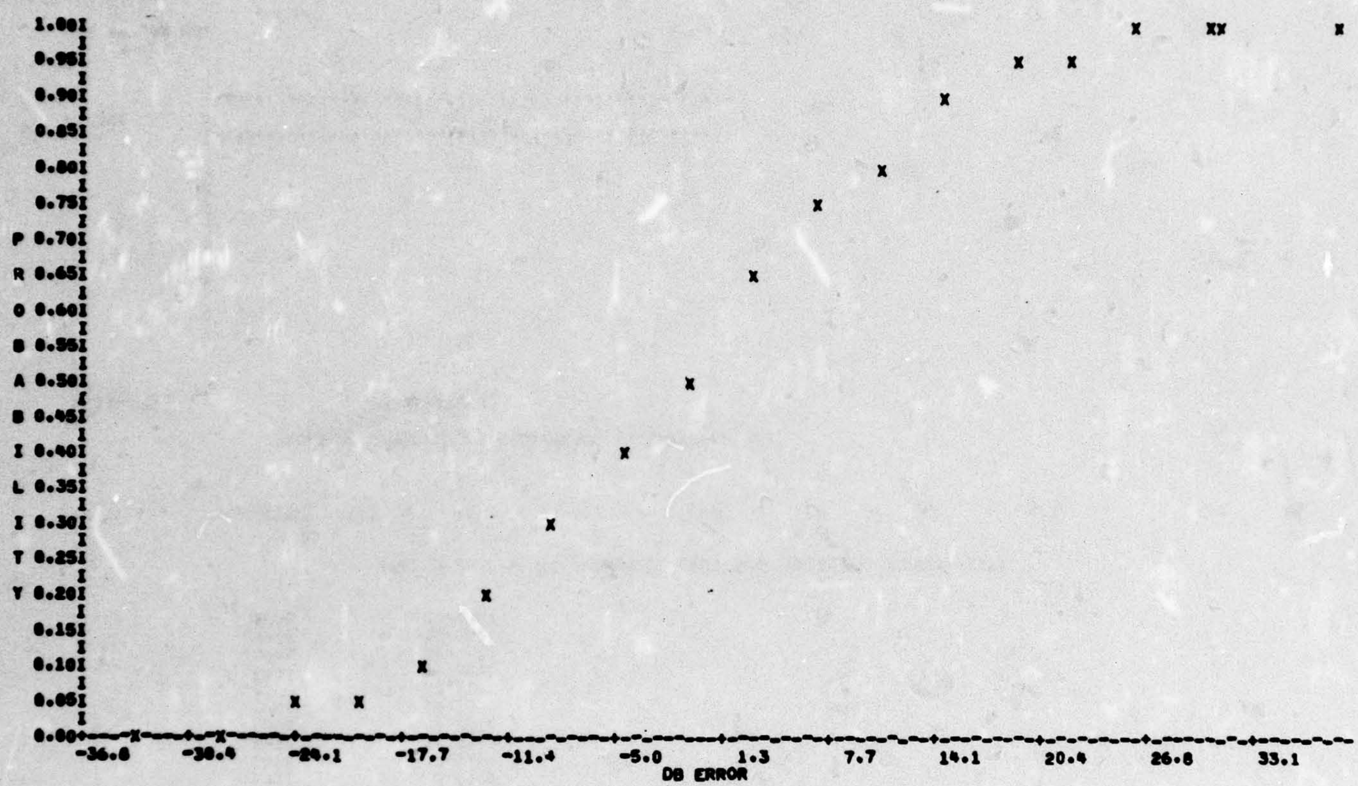
ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)	PITCH ANG. (DEG.)	ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	CO
1	1	DISH-12INCH	5	4	.0	V	12.0	.0	0.	0.	.0	240.0	300.0	90.0	90.0	0
2	1	TX. DIPOLE	0	4	3.0	X	.0	.0	0.	0.	10.0	220.0	150.0	.0	.0	0

```
ANT. TYPE INDICATORS:  0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS:  1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO):  0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED
```

Figure E-16. Printout of Sample Run #5.
(page 1 of 3)

EQUIPMENTS CAUSING POSSIBLE INTERFERENCE (BASED UPON UPPER DECILE PI PARAMETERS)
**** PI BELOW IS THE EFFECTIVE MEDIAN INTERFERENCE POWER FOR THE FUNCTIONAL CLASSES ANALYZED ****

RECEIVER	TRANSMITTER	PI	=	PT	+	GT	+	GR	-	LP	-	LF	+	S/I	=		>	RS ?	CODES	
VL TWO	ATC.XPONDER	PI	=	56.0	+	0.1	+	3.0	-	44.6	-	145.5	+	20.0	=	-104.2	>	-98.6	M=1	.0



THE PREDICTED PROBABILITY OF INTERFERENCE VS. DB. ERROR

Figure E-16. (Page 2 of 3)

```
ACTUAL COORDINATES OF POINTS ON THE CONVOLVED CUMULATIVE ERROR PLOT:

         PROBABILITY         DB  ERROR
         -----------         ---------

               .0040          -36.8505
               .0080          -32.8587
               .0170          -27.3859
               .0390          -23.4925
               .0690          -19.7416
               .1240          -15.6148
               .1840          -11.7849
               .2790           -7.7923
               .3750           -3.8238
               .4980             .1184
               .6320            3.9946
               .7290            7.9644
               .8130           11.8913
               .8870           15.7210
               .9440           19.7894
               .9750           23.5913
               .9890           27.0281
               .9960           31.4123
               .9970           32.0827
              1.0000           39.4587

                    CULLED EQUIPMENTS (POWER IS LESS THAN RECEIVER SENSITIVITY)

RECEIVER   TRANSMITTER   PI  =  PT  +  GT  +  GR  -  LP  -  LF  +  S/I  =     <  RS    CODES

                TABLE OF INTERFERING EQUIPMENTS (X=INTERFERING)

RECEIVERS                 TRANSMITTERS

             A
             T
             C
             .
             X
             P
             O
             N
             D
             E
             R
             ..............................................
VL TWO       X
             ..............................................

END OF JOB NO.   1

END OF RUN
```

Figure E-16. (Page 3 of 3)

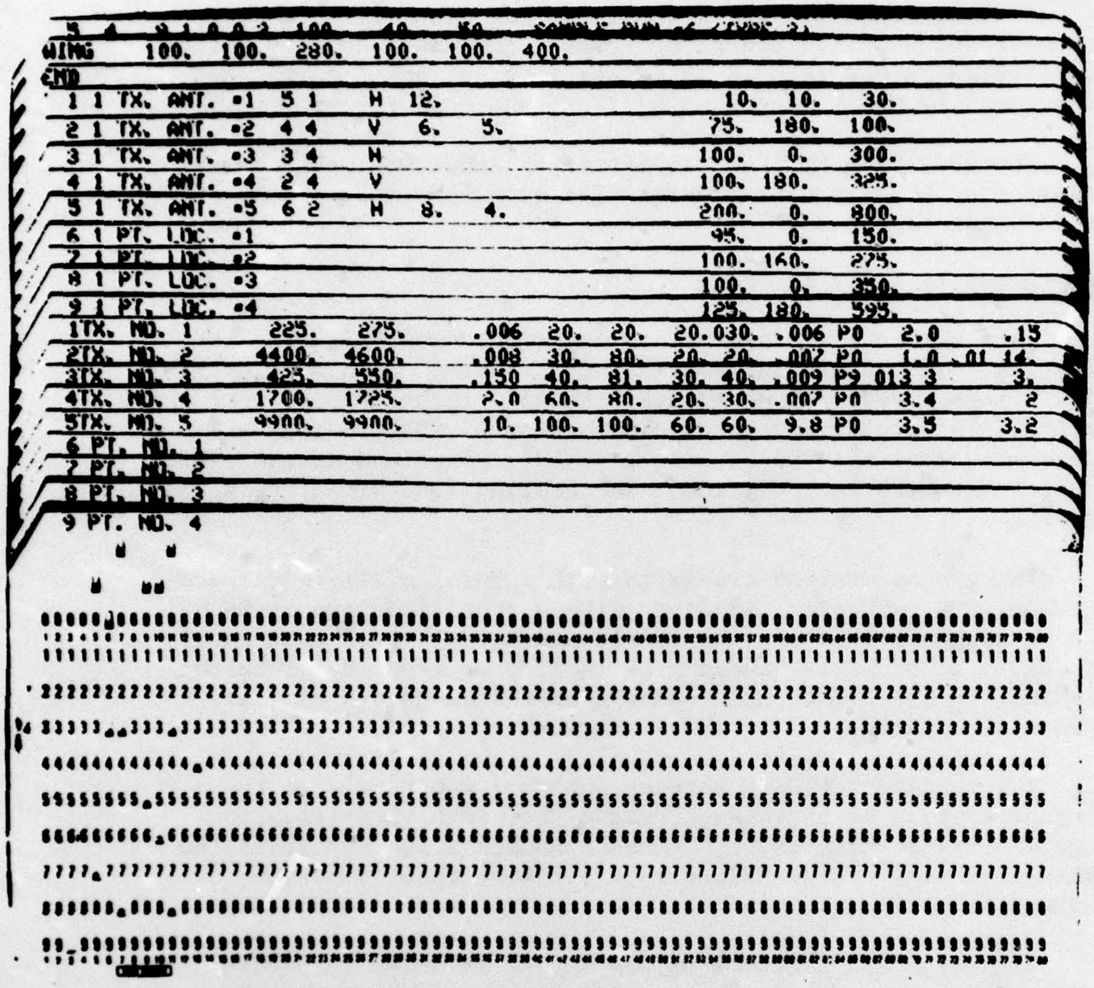


Figure E-17. Data card deck for Sample Run #6.

A bulkhead of height 40 inches, located 50 inches aft of the fuselage nose, is to be considered. An airfoil is to be considered as a potential obstruction to the transmission path. The front wing edges are located 280 inches aft of the fuselage nose. The aft wing edges are located 400 inches aft of the nose. The port wing-fuselage intersection points are located at 100° with respect to the vertical stabilizer. The five transmitter antennas are all different types and mounted at various locations about the aircraft. They also represent a mixture of polarizations and sizes. The four power density points are also located at different points about the aircraft.

All five transmitters are pulsed, but use a mixture of frequencies and emission characteristics. The power density points illustrated in Figure E-18 as points 1, 2, 3, and 4 correspond power density point locations 6, 7, 8, and 9 in the program cards.

The locations of the transmitter antennas and power density points are shown in Figure E-18. The output from Sample Run #6 is shown in Figure E-19.

SAMPLE RUN #7 (TYPE #22 RUN)

This sample run performs an intersite, probabilistic, INR analysis. Inputs are in the aircraft industry coordinate system. Site 1 is a fixed ground station with an altitude of 100 feet and site 2 is a satellite with an altitude of 99,999,999 feet above the earth. The heading of site 2 is 30°. A ground distance of 50 statute miles is specified. The bearing from site 1 to site 2 is 20°.

The ground station transmits with a horizontally polarized antenna, 999 inches in diameter, with a specified gain of 99 dBi. The satellite receives with a horizontally polarized antenna of 20 dBi. The receiving antenna is located at a point 10° to the right of the satellite axis and the main beam points directly down at the earth.

The transmitter uses antenna number 1 and retrieves the characteristics of the AVFILE transmitter with identification number 3. The receiver uses antenna number 2 and retrieves the characteristics of the AVFILE receiver with identification number 52.

The data card deck for Sample Run #7 is shown in Figure E-20. The output for Sample Run #7 is shown in Figure E-21. As can be seen, no interference is expected to occur.

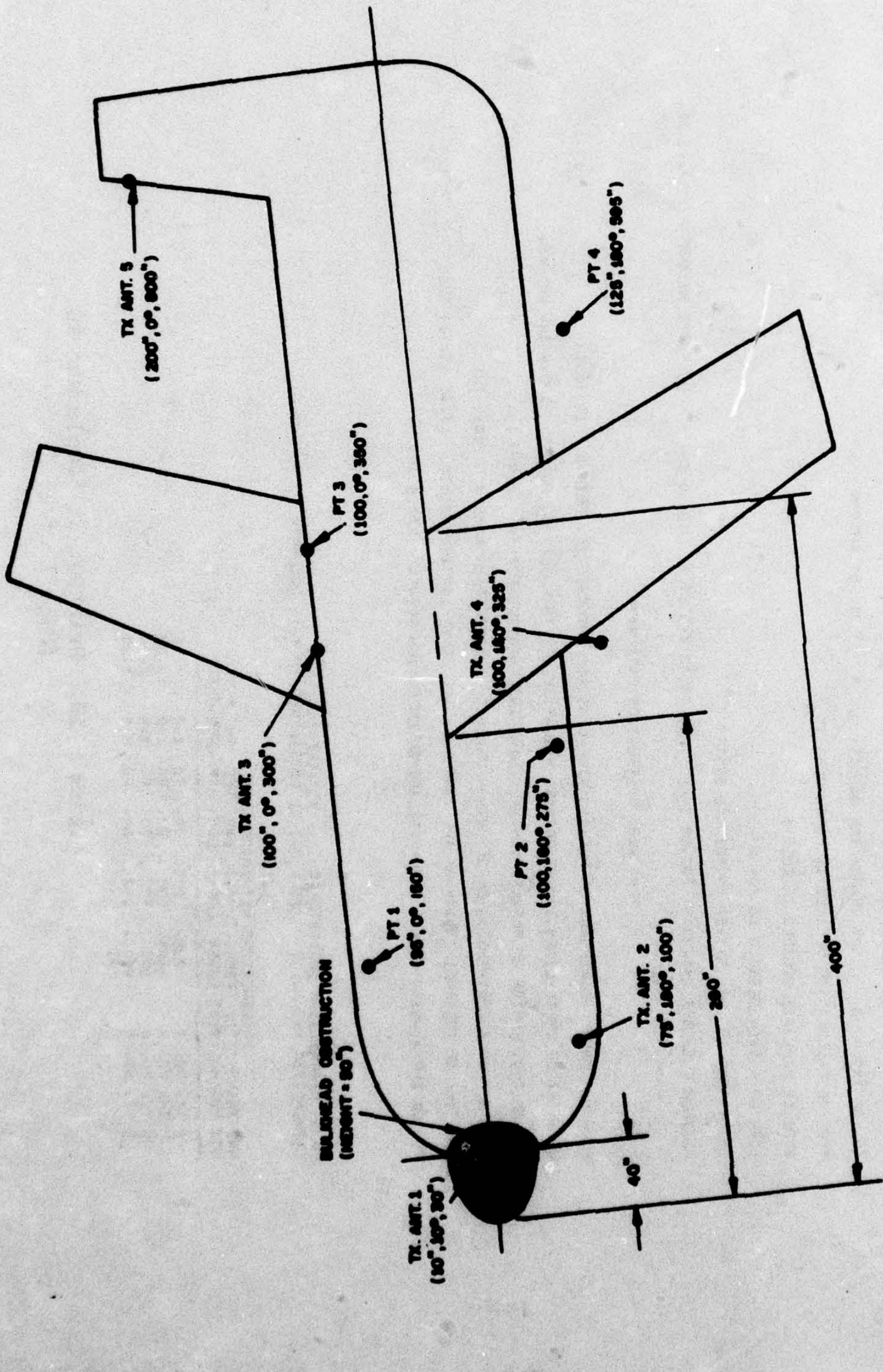


Figure E-18. Location of transmitter antennas and power density points for Sample Run #6.

```
                     AVPAK3 PROGRAM OUTPUT
     PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
                     ANNAPOLIS, MARYLAND

     **** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN #6 (TYPE 3)

NO. OF TXS =  5      NO. OF RXS (OR POINTS) =   4      NO. OF ANTS =   9

TYPE OF CALCULATION DESIRED IS POWER DENSITY

TYPE OF ANALYSIS DESIRED IS COSITE

TYPE OF ANSWER DESIRED IS PD, N/A

INPUTS ARE IN THE (R,T,Z) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS =  100.00 IN.     BULKHEAD Z-DIST =   40.00 IN.     BULKHEAD HEIGHT =   50.00 IN.

                     **** WING OBSTRUCTION DATA ****

BL-, X-, OR RHO-DIMENSION OF FORWARD WING-FUSELAGE INTERSECTION POINT=   100.0 IN.

WL-, Y-, OR THETA-DIMENSION OF FORWARD WING-FUSELAGE INTERSECTION POINT=   100.0 IN. OR DEG.

FS- OR Z-DIMENSION OF FORWARD WING-FUSELAGE INTERSECTION POINT=   280.0 IN.

BL-, X-, OR RHO-DIMENSION OF AFT WING-FUSELAGE  INTERSECTION POINT=   100.0 IN.

WL-, Y-, OR THETA-DIMENSION OF AFT WING-FUSELAGE  INTERSECTION POINT=   100.0 IN. OR DEG.

FS- OR Z-DIMENSION OF AFT WING-FUSELAGE INTERSECTION POINT=   400.0 IN.


PULSE COMPRESSION INDICATOR 0      IS ILLEGAL
TRANSMITTER TX. NO. 3     WILL NOT BE CONSIDERED IN THIS ANALYSIS
```

TRANSMITTERS WITH GOOD DATA

ANT NO.	TRANSMITTER NOMENCLATURE	FREQ. (MHZ.) LOWER	UPPER	PWR. DBM.	MOD TYP	PW USEC	PRF KHZ.
1	TX. NO. 1	225.	275.	30.	PO	2.0	.15
2	TX. NO. 2	4400.	4600.	20.	PO	1.0	14.00
4	TX. NO. 4	1700.	1725.	30.	PO	3.4	2.00
5	TX. NO. 5	9900.	9900.	60.	PO	3.5	3.20

Figure E-19. Printout of Sample Run #6.
(Page 1 of 3)

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE	FREQ (MHZ.) LOWER	UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IM REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	UPPER	LO POS	SENS. (DBM)	S/I (DB)
6	PT. NO. 1	0.	0.	.000	0.	0.	0.	0.	0.	0.	0.		0.	0.
7	PT. NO. 2	0.	0.	.000	0.	0.	0.	0.	0.	0.	0.		0.	0.
8	PT. NO. 3	0.	0.	.000	0.	0.	0.	0.	0.	0.	0.		0.	0.
9	PT. NO. 4	0.	0.	.000	0.	0.	0.	0.	0.	0.	0.		0.	0.

ANTENNAS WITH GOOD DATA

ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)	PITCH ANG. (DEG.)	ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	C O
1	1	TX. ANT. #1	5	1	.0	H	12.0	.0	0.	0.	10.0	10.0	30.0	90.0	90.0	0
2	1	TX. ANT. #2	4	4	.0	V	6.0	5.0	0.	0.	75.0	180.0	100.0	90.0	90.0	0
3	1	TX. ANT. #3	3	4	2.0	H	.0	.0	0.	0.	100.0	.0	300.0	.0	.0	0
4	1	TX. ANT. #4	2	4	2.0	V	.0	.0	0.	0.	100.0	180.0	325.0	.0	.0	0
5	1	TX. ANT. #5	6	2	.0	H	8.0	4.0	0.	0.	200.0	.0	800.0	90.0	90.0	0
6	1	PT. LOC. #1	0	0	.0		.0	.0	0.	0.	95.0	.0	150.0	.0	.0	0
7	1	PT. LOC. #2	0	0	.0		.0	.0	0.	0.	100.0	160.0	275.0	.0	.0	0
8	1	PT. LOC. #3	0	0	.0		.0	.0	0.	0.	100.0	.0	350.0	.0	.0	0
9	1	PT. LOC. #4	0	0	.0		.0	.0	0.	0.	125.0	180.0	595.0	.0	.0	0

ANT. TYPE INDICATORS: 0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS: 1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO): 0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED

Figure E-19. (Page 2 of 3)

POWER DENSITIES

RX. OR POINT	TRANSMITTER	PD	=	PT	+	GT	-	LP	+	20LOG(F)	-	30.5		DBM/M**2		FLD. STRENGTH (V/M)
PT. NO. 1	TX. NO. 1	PD(PEAK)	=	30.0	+	-4.6	-	52.4	+	48.0	-	30.5	=	-17.6	=	.1
PT. NO. 1	TX. NO. 1	PD(AVG.)	=	-5.2	+	-4.6	-	52.4	+	48.0	-	30.5	=	-52.8	=	.0
PT. NO. 1	TX. NO. 2	PD(PEAK)	=	20.0	+	-2.5	-	152.2	+	73.1	-	30.5	=	-100.1	=	.0
PT. NO. 1	TX. NO. 2	PD(AVG.)	=	1.5	+	-2.5	-	152.2	+	73.1	-	30.5	=	-110.7	=	.0
PT. NO. 1	TX. NO. 4	PD(PEAK)	=	30.0	+	2.0	-	122.6	+	64.7	-	30.5	=	-64.4	=	.0
PT. NO. 1	TX. NO. 4	PD(AVG.)	=	8.3	+	2.0	-	122.6	+	64.7	-	30.5	=	-86.1	=	.0
PT. NO. 1	TX. NO. 5	PD(PEAK)	=	60.0	+	-4.4	-	76.8	+	79.9	-	30.5	=	20.2	=	6.3
PT. NO. 1	TX. NO. 5	PD(AVG.)	=	40.5	+	-4.4	-	76.8	+	79.9	-	30.5	=	.7	=	.7
		CUMULATIVE AVERAGE POWER DENSITY DUE TO ALL TXS.	=											.7	=	.7
PT. NO. 2	TX. NO. 1	PD(PEAK)	=	30.0	+	-4.6	-	62.0	+	48.0	-	30.5	=	-27.2	=	.0
PT. NO. 2	TX. NO. 1	PD(AVG.)	=	-5.2	+	-4.6	-	62.0	+	48.0	-	30.5	=	-62.4	=	.0
PT. NO. 2	TX. NO. 2	PD(PEAK)	=	20.0	+	-2.5	-	61.0	+	73.1	-	30.5	=	-8.9	=	.2
PT. NO. 2	TX. NO. 2	PD(AVG.)	=	1.5	+	-2.5	-	61.0	+	73.1	-	30.5	=	-27.5	=	.0
PT. NO. 2	TX. NO. 4	PD(PEAK)	=	30.0	+	2.0	-	43.8	+	64.7	-	30.5	=	14.4	=	3.2
PT. NO. 2	TX. NO. 4	PD(AVG.)	=	8.3	+	2.0	-	43.8	+	64.7	-	30.5	=	-7.3	=	.3
PT. NO. 2	TX. NO. 5	PD(PEAK)	=	60.0	+	-4.4	-	132.7	+	79.9	-	30.5	=	-35.7	=	.0
PT. NO. 2	TX. NO. 5	PD(AVG.)	=	40.5	+	-4.4	-	132.7	+	79.9	-	30.5	=	-55.2	=	.0
		CUMULATIVE AVERAGE POWER DENSITY DUE TO ALL TXS.	=											-7.3	=	.3
PT. NO. 3	TX. NO. 1	PD(PEAK)	=	30.0	+	-4.6	-	60.6	+	48.0	-	30.5	=	-25.8	=	.0
PT. NO. 3	TX. NO. 1	PD(AVG.)	=	-5.2	+	-4.6	-	60.6	+	48.0	-	30.5	=	-61.0	=	.0
PT. NO. 3	TX. NO. 2	PD(PEAK)	=	20.0	+	-2.5	-	148.4	+	73.1	-	30.5	=	-96.4	=	.0
PT. NO. 3	TX. NO. 2	PD(AVG.)	=	1.5	+	-2.5	-	148.4	+	73.1	-	30.5	=	-114.9	=	.0
PT. NO. 3	TX. NO. 4	PD(PEAK)	=	30.0	+	2.0	-	126.9	+	64.7	-	30.5	=	-68.8	=	.0
PT. NO. 3	TX. NO. 4	PD(AVG.)	=	8.3	+	2.0	-	126.9	+	64.7	-	30.5	=	-90.4	=	.0
PT. NO. 3	TX. NO. 5	PD(PEAK)	=	60.0	+	-4.4	-	73.7	+	79.9	-	30.5	=	23.3	=	8.9
PT. NO. 3	TX. NO. 5	PD(AVG.)	=	40.5	+	-4.4	-	73.7	+	79.9	-	30.5	=	3.8	=	.9
		CUMULATIVE AVERAGE POWER DENSITY DUE TO ALL TXS.	=											3.8	=	.9
PT. NO. 4	TX. NO. 1	PD(PEAK)	=	30.0	+	-4.6	-	69.2	+	48.0	-	30.5	=	-34.3	=	.0
PT. NO. 4	TX. NO. 1	PD(AVG.)	=	-5.2	+	-4.6	-	69.2	+	48.0	-	30.5	=	-69.6	=	.0
PT. NO. 4	TX. NO. 2	PD(PEAK)	=	20.0	+	-2.5	-	67.6	+	73.1	-	30.5	=	-15.5	=	.1
PT. NO. 4	TX. NO. 2	PD(AVG.)	=	1.5	+	-2.5	-	67.6	+	73.1	-	30.5	=	-34.0	=	.0
PT. NO. 4	TX. NO. 4	PD(PEAK)	=	30.0	+	2.0	-	53.9	+	64.7	-	30.5	=	4.3	=	1.0
PT. NO. 4	TX. NO. 4	PD(AVG.)	=	8.3	+	2.0	-	53.9	+	64.7	-	30.5	=	-17.4	=	.1
PT. NO. 4	TX. NO. 5	PD(PEAK)	=	60.0	+	-4.4	-	127.8	+	79.9	-	30.5	=	-30.8	=	.0
PT. NO. 4	TX. NO. 5	PD(AVG.)	=	40.5	+	-4.4	-	127.8	+	79.9	-	30.5	=	-50.4	=	.0
		CUMULATIVE AVERAGE POWER DENSITY DUE TO ALL TXS.	=											-17.3	=	.1

Figure E-19. (Page 3 of 3)

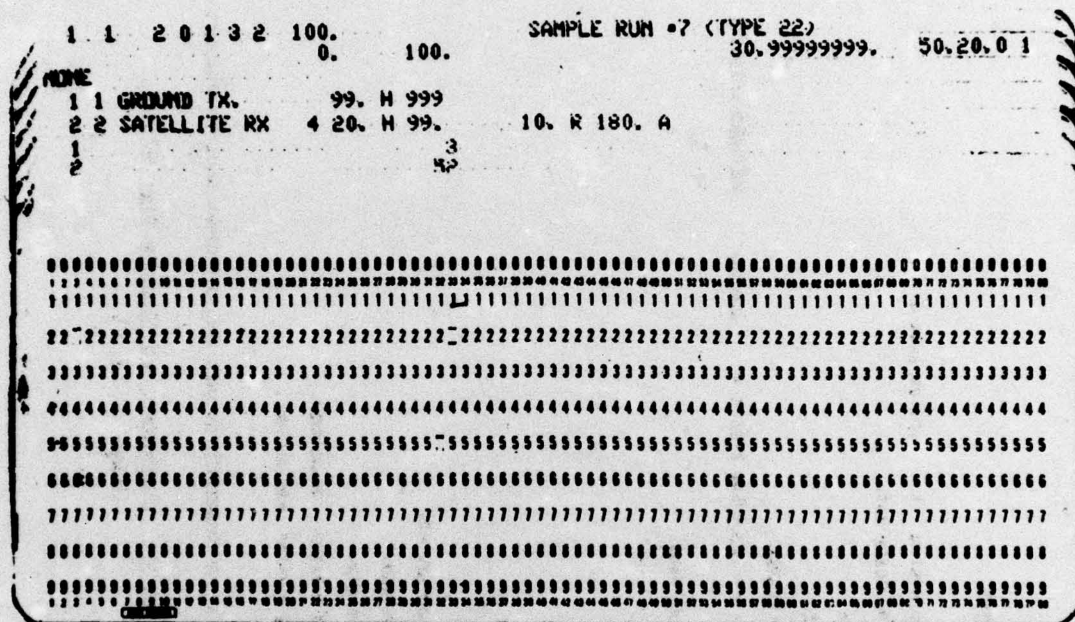


Figure E-20. Data card deck for Sample Run #7.

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                        AVPAK3 PROGRAM OUTPUT
        PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
                        ANNAPOLIS, MARYLAND


    **** GENERAL PARAMETERS INPUT ****

JOB TITLE: SAMPLE RUN #7 (TYPE 22)

NO. OF TXS = 1     NO. OF RXS (OR POINTS) =  1     NO. OF ANTS =  2

TYPE OF CALCULATION DESIRED IS INT. TO NOISE RAT.

TYPE OF ANALYSIS DESIRED IS INTERSITE

TYPE OF ANSWER DESIRED IS PROBABILISTC

INPUTS ARE IN THE (B,W,F) COORDINATE SYSTEM

MAXIMUM FUSELAGE RADIUS =  100.00 IN.     BULKHEAD Z-DIST =     .00 IN.     BULKHEAD HEIGHT =     .00 IN.


    **** INTERSITE ANALYSIS PARAMETERS ****

SITE 1 IS FIXED

SITE 2 IS MOVING

HEADING OF SITE 1=     .00 DEG.

HEADING OF SITE 2=  30.00 DEG.

ALTITUDE OF SITE 1 =       100.00 FT.

ALTITUDE OF SITE 2 = 99999999.00 FT.

GROUND DISTANCE BETWEEN SITES =   50.00 ST. MI.

BEARING FROM SITE 1 TO SITE 2=   20.00 DEG.

BEARING FROM SITE 2 TO SITE 1=  200.00 DEG.

VERTICAL ANGLE BETWEEN SITE 1 TO SITE 2 PATH=   89.85 DEG.

VERTICAL ANGLE BETWEEN SITE 2 TO SITE 1 PATH=  -89.85 DEG.


**** THERE ARE NO OTHER OBSTRUCTIONS TO BE CONSIDERED IN THIS ANALYSIS OTHER THAN THE AIRCRAFT FUSELAGE ****
```

Figure E-21. Printout of Sample Run #7.
(Page 1 of 3)

TRANSMITTERS WITH GOOD DATA

ANT NO.	TRANSMITTER NOMENCLATURE	FREQ. (MHZ.) LOWER	FREQ. (MHZ.) UPPER	BW1 MHZ.	BW2 MHZ.	SF1 (DB/DEC.)	SF2 (DB/DEC.)	PWR. DBM.	MOD TYP	PCI	PW USEC	R/PT USEC	EDBW MHZ.	FILTER (MHZ.) LOWER	FILTER (MHZ.) UPPER	# H	HARMONIC SUPPRESSION LEVELS (DB.) HARMONIC NUMBER 2	3	4	5	6	7	8	9
1	WEATHERRADAR	9315.	9415.	.204	3.3	20.0	42.0	73.	PO		3.1	.194	3.4	6486.	15230.	2	61.	0.	0.	0.	0.	0.	0.	0.

RECEIVERS OR POINTS WITH GOOD DATA

RX. ANT. NO. OR POINT NO.	RX. OR POINT NOMENCLATURE	FREQ (MHZ.) LOWER	FREQ (MHZ.) UPPER	IF BW (MHZ.)	IF (MHZ.)	IF SLOPE (DB/DEC)	RF SLOPE (DB/DEC)	IM REJ (DB)	SP REJ (DB)	SPUR FREQS (MHZ.) LOWER	SPUR FREQS (MHZ.) UPPER	LO POS	SENS. (DBM)	S/I (DB)
2	VL THREE	100.	118.	.037	26.	174.	60.	80.	116.	16.	266.	C	-97.	20.

ANTENNAS WITH GOOD DATA

ANT NO.	SITE NO.	ANTENNA NOMENCLATURE	TYPE IND.	LOC. IND.	GAIN DBI.	POLAR.	X-DIM. (IN.)	Y-DIM. (IN.)	ROLL ANG. (DEG.)		PITCH ANG. (DEG.)		ANTENNA LOCATION (IN/DEG.) (X,Y,Z),(B,W,F),OR (R,T,Z)			PHI (DEG)	THETA (DEG)	CO
1	1	GROUND TX.	0	0	99.0	X	****	.0	0.		0.		.0	.0	.0	.0	.0	0
2	2	SATELLITE RX	0	4	20.0	X	99.0	.0	10.	R	180.	A	.0	.0	.0	.0	.0	0

ANT. TYPE INDICATORS: 0=NOT APPLICABLE, 1=DIPOLE, 2=LOOP, 3=BLADE, 4=HORN, 5=CIRCULAR APER., 6=RECTANGULAR APER.
ANT. LOCATION INDICATORS: 1=NOSE, 2=TAIL, 3=WING, 4=FUSELAGE, 5=WEAPON
COORDINATE ORIGIN LOCATION (CO): 0=FUSELAGE, 1-6=COORDINATE SYSTEM OF WEAPON NO. INDICATED

EQUIPMENTS CAUSING POSSIBLE INTERFERENCE (BASED UPON UPPER DECILE PI PARAMETERS)
**** PI BELOW IS THE EFFECTIVE MEDIAN INTERFERENCE POWER FOR THE FUNCTIONAL CLASSES ANALYZED ****

RECEIVER TRANSMITTER PI = PT + GT + GR - LP - LF + S/I = > RS ? CODES

Figure E-21. (Page 2 of 3)

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                    CULLED EQUIPMENTS (POWER IS LESS THAN RECEIVER SENSITIVITY)

RECEIVER   TRANSMITTER   PI =  PT   +  GT   +  GR   -  LP    -  LF    +  S/I  =        <  RS     COMES

VL THREE   WEATHERRADAR  PI =  73.0 +  99.0 +  20.0 -  202.0 -  400.0 +  20.0 = -390.0 < -97.3  N=1

      --                          05 OCT 76          PAGE   2     U N C L A S S I F I E D

                       AVPAK3 PROGRAM OUTPUT
        PERFORMED AT THE ELECTROMAGNETIC COMPATIBILITY ANALYSIS CENTER
                        ANNAPOLIS, MARYLAND

          TABLE OF INTERFERING EQUIPMENTS (X=INTERFERING)

RECEIVERS            TRANSMITTERS

               W
               E
               A
               T
               H
               E
               R
               R
               A
               D
               A
               R
               ...............................................
VL THREE
               ...............................................

END OF JOB NO.    1
END OF RUN
```

Figure E-21. (Page 3 of 3)

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